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21 JANUARY 1987

CHINA REPORT

SCIENCE AND TECHNOLOGY

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MAI PERSONNEL SUCCEED UPON RETURN FROM STUDY ABROAD

Beijing GUANGMING RIBAO in Chinese 27 Oct 86 p 1

[Article: Ministry of Aeronautics Industry Trains High-Level Technical 'Software'; 570 of the 814 students sent abroad have already returned to the PRC and Are Playing Key Roles in Scientific Research and Production"]

[Text] The Ministry of Aeronautics Industry [MAI] in selecting personnel to go abroad for study is willing to spend a large amount of money to train high-level technical "software." For the past 8 years, the MAI through different channels has assigned 814 people to study abroad, of which 570 have already returned to China. Most of these returnees achieved considerable research results while abroad, and 25 people earned PhD. degrees. According to a sample survey taken at the beginning of 1986 from personnel who have returned to 35 factories and institutes in China, 23.8 percent made a significant contribution in their unit or specialization, and approximately 53 percent had done outstanding work and achieved definite scientific research results.

According to our understanding, most people returning from study abroad have become leading academicians or innovators in their fields, and some have even won broad international recognition. Han Ruixiang [7281 3843 4382] of the Second Design Institute of the MAI's Guizhou Management Bureau assumed the position of the institute's chief engineer after returning from abroad, and many times solved key technical problems with regard to engine experiments, and was commended by the relevant departments. When Ding Peifan [0002 1014 3879] returned to the Beijing Aeronautics Technology Institute from abroad after earning a PhD. in Germany, he set strict demands on himself in every respect. Last year he successfully designed China's first electron beam welder for export.

Last year, Professor Li Wei [2621 2607] of the Beijing Aeronautics College returned from abroad after earning a PhD., and in one year he completed a large-scale auxiliary circuit design that was of an advanced 1980s technological level. Currently, he is one of the country's youngest advisors to PhD. students, and has already been promoted by his school to a full Professor.

In the new system established by the MAI in which the civilian and military are integrated, numerous people who have returned from study abroad have made great efforts to develop projects which earn significant economic results, and have achieved definite success. Zhang Lisheng [4545 4539 0524] of the MAI's Hard Alloy Tool Factory made use of new technology he had studied while abroad to research the technology used for forming hard alloy screw blades. The results were at the level of similar international products. When put into

production, China can thus conserve a large amount of foreign exchange. After the young professor Xun Ji [6737 2817] returned to China from study abroad, he applied a microcomputer-controlled system which he developed himself to transform a domestically-produced milling machine, and he "brought back to life" more than 100 machines. Within a year the economic benefits gained from this transformation totalled 30 million yuan, and the project was praised by leaders of the Central Military Commission.

In order to give full play to the roles of those returning to China from study abroad, the MAI in recent years has drawn up relevant regulations, and has set up study on special subjects. Every two years, MAI engages in a comprehensive survey of the circumstances for using personnel who have returned from study abroad. Those who have succeeded in their work, and have been commended and promoted for exceptional performance have aroused the enthusiasm of everybody.

CSO: 4008/2037

NATIONAL DEVELOPMENTS

POLICY ON STUDENTS STUDYING ABROAD ADJUSTED

Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 22 Nov 86 p 4

[Article: Proportion of Academic Disciplines to Be Adjusted to Stress Applications; Standards Used [for Selecting] Graduate Students Studying Abroad Will Be Raised a Level to Favor PhD Candidates"]

[Text] Albany: China State Education Commission Member and Chairman of the China International Education Exchange Association Huang Xinbai [7806 6580 4101] when meeting with PRC students studying at SUNY Albany on 19 November introduced a policy in which the state will make adjustments in students studying abroad.

Huang Xinbai said that the main channels through which PRC students study abroad can be divided as follows: 1) government funded; 2) funded through schools, academic research organizations and production units themselves, or jointly sent in conjunction with foreign organizations; and 3) self-funded. These three types of students will continue to be sent abroad, but the proportion of students in different academic disciplines will be adjusted. Currently, a fairly high number of PRC students in the U.S. are in science departments, while few study applied sciences. In the future these proportions will be readjusted lest a surfeit of students is allowed in one discipline after these students return home.

In addition, funding for students sent abroad will be at a higher level to allow those with limited money to play a significant role. In the future, most students sent abroad to study will have college credentials, and high school graduates will not be sent abroad except for a small number of special courses. Even though self-funded students will not be affected by these restrictions, before they go abroad we must still consider whether their studies will have been of use when they do return.

With regard to graduate students, Huang Xinbai feels that China also must adjust the number of PhD candidates. Currently, the number of graduate students China has trained total 40,000, and the quality of the PRC's college students and graduate students is not at all inferior to foreign countries. Because the state has a training capability, the future level of graduate students sent abroad will be a level higher, and China will lean toward sending PhD students abroad.

Huang has already discussed with a few foreign universities his plan for jointly training PhD students. In the future, a portion of the research work of PhD students will be done abroad, and a portion can also be done at home. At the same time China can invite foreign professors to act as consultants, and to come to China to give personal guidance. This way China can conserve financial and human resources, research subjects will be integrated with the state's needs, and China can speed up its ability to train PhD's. Huang has had contact with colleges in Canada, the U.S., West Germany, the Soviet Union and Japan, and has received unanimous endorsement.

With regard to the qualifications of visiting scholars, Huang said that college graduates must have 5 years work experience and graduate school graduates must have 2 years of work experience in order to go abroad with visiting-scholar status.

Huang Xinbai also mentioned that China currently has 17,000 students studying in the U.S., and each year 7,000 to 8,000 students go to the U.S. to pursue studies. Whether or not this pace can be coordinated with the state's need for talented personnel and with job arrangements for students who have returned to the PRC is worth looking into and considering further. It is necessary to readjust the current policy on students studying abroad in order to effectively preserve the state's human resources.

CSO: 4008/2020

NATIONAL DEVELOPMENTS

UNIVERSITIES SHORT OF RESEARCH FUNDS

Beijing CHINA DAILY in English 25 Dec 86 p 4

[By reporter Zhang Lin]

[Text] The shortage of funds allocated by the State to China's universities and colleges has hampered the development of scientific research in the country's educational departments.

According to a survey, the amount allocated for scientific research to the country's universities and colleges is only one tenth of the total that donated to other scientific research institutions.

Considering their capabilities for doing research. China's higher educational institutions are no less competent than those off campus, Guangming Daily said.

By the end of 1985, there were about 355,000 scientists and engineers in China's 759 universities and colleges, against 231,000 for the out-of-campus research institutions. Among those with senior professional titles, about 67 percent of them are in the colleges and universities. In 1985, China's higher educational departments provided about 63,000 research papers and 73 approved patents compared with 24,000 papers and 19 patents provided by outside scientific institutions.

But when it comes to funding, the amount per person donated to scientific institutions is 8.3 times that of the universities and colleges.

This irrational distribution of scientific funds is the main obstacle to the development of scientific research on campus.

It is common practice worldwide for the development of scientific research to be closely associated with the development of education, especially higher education, the paper said.

But in China, owing to flaws in its scientific management system, education is separated from scientific research. So when deciding the distribution of funds for scientific research, central and local governments only allocate funds to the institutions. The money universities and colleges need to do research can only be obtained from the education budget -- a modest sum.

Some improvements have been made in the past few years and the channels through which the universities and colleges can obtain funds for scientific research have been thus expanded.

Now the universities and colleges can compete with the institutions for funding for a scientific project. The State foundation for scientific research is also able to provide funds for universities and colleges.

Even so, universities and colleges usually fail in their bids because the shortage of cash has led to the poor condition of their laboratories compared with those in scientific institutions, so they are not on an equal footing when competing, Guangming Daily said.

Measures

When the State draws up plans for scientific development, professors and other research members in the universities are usually invited and their opinions are considered valuable. But when it comes to allotting funds, these same professors are shunned. They feel strongly that the role that universities and colleges played in the country's scientific development should be greatly strengthened.

Some tentative measures could be adopted toward this end.

A new system combining the development of science and technology with education should be formed to reduce the number of research institutions independent of enterprises and higher institutions and make the system more effective. In this way, the development of scientific research can be more closely linked to the development of the economy and education.

The universities and colleges could cover such fields as basic research and applied science, while the enterprises could undertake the job of developing new products. They should also strengthen cooperation between them.

The system of fund allocation for scientific research should be reformed.

The government should give more financial help to higher educational institutions. Preferential measures should be given when universities and out-of-campus institutions are competing for funding.

Enterprises should be encouraged to invest in colleges and universities to provide more channels for the higher educational departments to obtain funds.

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CSO: 4010/2004

NATIONAL DEVELOPMENTS

SUPPORT FOR PRIVATE RESEARCH INSTITUTIONS URGED

OW071216 Beijing XINHUA in English 1030 GMT 7 Dec 86

[Text] Beijing, 7 Dec (XINHUA)--Today's PEOPLE'S DAILY calls for support for privately or collectively-run research units, engaged mainly in technical development, services, consultancy and training, which number about 10,000 across China.

The paper notes in a front-page report that many scientists and technicians gave away their "iron rice bowls" at state-run research institutes and have set up their own institutes in the past two or three years, without any state investment.

As a new form of organization thriving at the science and technological field, these institutes are competing actively with the research units owned by the state and have greatly contributed to the country's economic construction.

These institutes, guided by directors or managers, who are all professionals, are geared to economic construction, pay their own research funds, decide on research projects by themselves and have been winning an increasing number of clients," the paper said.

"The combination of research, production and trading demonstrates their great flexibility and vitality," it said.

However, the report said that the number of private research units reduced drastically between late 1985 and early 1986 because of heavy taxes and unreasonable charges and social bias against them. The number of such institutes in Shanghai and Nanjing decreased by nearly 40 percent during this period, it added.

Moreover, numerous taxes and charges levied on them involve the taxes concerning business, income, bonuses, urban construction maintenance, energy as well as management fees.

A research company in Beijing imported some micro computers from abroad in 1985 and, after developing some equipment and software, sold them at a slightly higher price. But they were later fined 270,000 yuan (about 72,900 U.S. dollars) by a local price control department on a charge of speculation.

In addition, it said, some people regard those leaving state research institutes to work in private institutions as "speculating" or "not engaging in honest work". "Such a bias is also a pressure on scientists," it said.

The paper urges the improvement of current policies and regulations so as to give scope to the initiative of private research institutes and ensure their healthy development.

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CSO: 4010/2004

NATIONAL DEVELOPMENTS

SURVEY SAYS MOST SCIENTISTS IN SHANGHAI 'WASTED'

OW021432 Beijing XINHUA in English 0850 GMT 2 Dec 86

[Text] Beijing, 2 Dec (XINHUA)--A sample survey indicates that two-thirds of Shanghai's scientists and technicians are under utilized and their professional skills wasted, the PEOPLE'S DAILY reported today.

The Shanghai Municipal Bureau of Personnel and the Bureau of Scientists and Technicians completed a sample survey of more than 10,000 professionals from 400 work units. There are 550,000 technicians and scientists working in Shanghai, China's most industrialized city.

Analysis in the survey shows the scientists and technicians are often misplaced in a job, where there's a disparity between their expertise and position. Also overstaffing and lack of freedom to pursue more suitable employment were all cited as reasons for under utilization of their skills.

Of those people surveyed, 90 percent asked for freedom of job choice but 60 percent of the work units investigated do not allow exchanges between their technical staff, according to the newspaper.

About 45 percent complained of the disparity between their expertise and the demands of their job, said the daily.

Some of the professionals answered that they do not perform administrative work well and feel misplaced after promotion as cadres in recent years, said the party newspaper.

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CSO: 4010/2004

NATIONAL DEVELOPMENTS

PRC SPACE PHYSICS ACHIEVEMENTS REPORTED

OW140133 Beijing XINHUA Domestic Service in Chinese 0911 GMT 10 Nov 86

[Article by reporter Zhang Jimin]

[Text] Beijing, 10 Nov (XINHUA)--At an international seminar on space physics which opened in Beijing today, Chinese scientists revealed that China will build a space-probe rocket launch site to step up space observations and studies.

Early this year when Halley's Comet returned, experts of a number of countries conducted multifaceted studies of the comet by using satellites to probe into its nucleus. According to a report delivered by a Federal German expert at this international space physics seminar, on 13 March of this year when the detector was flying past Halley's Comet at a distance of 605 kilometers, it discovered that among the comet substances there is an unexpectedly high content of carbon, but no sodium at all. Another finding is that Halley's Comet emits its substances within a radius of 4,600 kilometers at a speed of 1 kilometer per second, whereas outside this scope no substances flow outwardly. Judging from the fact that the hydrogen and deuterium contents of Halley's Comet are in the ratio of 1 to 100,000, it is believed that this comet has always been a member of the solar system.

During the past few years, Chinese experts have also scored some achievements in space observations. The observation of whistlers of electromagnetic waves caused by lightning is one of the important methods to probe the outer space structure from the earth. According to the observation of Chinese experts, the lower latitude limit of such whistlers have moved nearly 1,000 kilometers toward the equator. This discovery has put China in the advanced rank in the world in the study of whistlers. In addition to this, our country has achieved significant research results in upper atmosphere dynamics and magnetosphere dynamics and in the study of ionospheric equatorial abnormalities.

A responsible person of the Space Physics Institute of the Chinese Academy of Sciences stated that the first space-probe rocket launch site and the associated observation station that China has decided to build for scientific research purposes are expected to be completed and become operational in the Seventh Five-Year Plan.

More than 200 experts from the United States, Japan, Britain, China, and 9 other countries are attending the international space physics seminar being held in Beijing. Among those present at today's opening session were noted physicists, including Zhou Guangzhao, Wang Dayan, and Lu Baowei.

NATIONAL DEVELOPMENTS

AIR FORCE HOLDS LASER/ELECTRONIC SIMULATOR TACTICAL CONFRONTATION EXERCISE

Shenyang LIAONING RIBAO in Chinese 29 Oct 86 p 3

[Article]

[Text] Yang Shangkun and Yu Qiuli of the Central Military Commission, today at an airfield in North China witnessed an Air Force laser/electronic simulator tactical combat exercise in which they highly praised the great successes achieved by the air force in improving its training.

Before the exercise got underway, Yang Shangkun and Yu Qiuli visited the air force training simulator exhibit. Over 1,000 pieces of simulation equipment, all recently developed by the Air Force, were displayed. Among the display items were original Chinese develop equipment, some of which was world class.

This combat exercise in which various air force branches and different troops participated used computer controls for ground fighting, air-to-ground attacks, and ground-to-air attacks. Every piece of equipment had lasers, infrared and electronic simulators, and in the entire exercise not one bullet or missile was wasted. The war-like atmosphere was true to life, and the outcome of the two belligerent parties was quickly and accurately determined.

The success of this exercise indicates that the Air Force's ground and air simulation exercises have developed from a simple technical model to a tactical model and from a simulator involving a single service arm and single type of equipment to a combined simulator involving main battle service arms and equipment. We have developed a viable electronic laser.

CSO: 4008/2033

NATIONAL DEVELOPMENTS

CHINA'S NUCLEAR SUBMARINE COMPLETES FIRST EXTENDED TRAINING CRUISE

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 1 Jan 87 p 1

[Text] Xinhuashe, Beijing, 31 Dec 86—China's nuclear submarine has successfully completed its first long-range training cruise.

The submarine service's cadres and seamen manning the nuclear sub completed all phases of the training mission and established records for time submerged, distance travelled, and average cruising speed within the Navy's submarine service.

This nuclear-powered submarine was entirely designed and built by China as was all the machinery and equipment. The submarine has great endurance and high speed, can remain submerged for extended periods and has good concealment capabilities.

The completion of the nuclear-powered sub's extended training cruise represents a new success for our Navy's modernization effort. It is reported that this submarine is now on active duty status.

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CSO, 4008/2037

NATIONAL DEVELOPMENTS

NEED FOR WEATHER RECONNAISSANCE AIRCRAFT STRESSED

OW071636 Beijing XINHUA in English 1457 GMT 7 Dec 86

["China Needs More Advanced Meteorological Aircraft -- Experts" -- XINHUA headline]

[Text] Beijing, 7 Dec (XINHUA)--Chinese experts urged the country's aircraft producers to build more aircraft to meet the growing needs for making artificial rainfalls, dispelling cloud over airfields, and monitoring typhoon and weather changes.

At a current national symposium here on developing China's civil aviation, meteorologists He Shao in and Guo Siming said, "China's weather reconnaissance aircraft now in service are out of date. They must be replaced immediately by more advanced aircraft."

"It is unrealistic for China to totally rely on importing weather reconnaissance aircraft," they said, adding that "the fundamental way is to develop its own weather reconnaissance aircraft."

They suggested that Chinese aviation experts develop three types of aircraft to serve a long-term demand.

The first type is a long-range high-altitude aircraft mainly used in observing weather changes and monitoring typhoons which frequently hit the southeastern part of the country. This kind of aircraft equipped with defrosters and radars, must be capable of flying at a height of 10,000 meters for a stretch of five hours.

The second type is a medium-range aircraft for physical surveys and artificial rainfall tests. It must be able to fly at 7,000 meters with a load of up to four tons.

The third type is a short-range aircraft which can fly three hours at 5,000-meters. Adept at flying at low altitudes, these aircraft are mainly used in monitoring pollution over urban areas.

China has a relatively short history of using aircraft in meteorological work. Since 1958, more than 20 provinces, municipalities and autonomous regions have experimented with cloud-seeding, according to experts.

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CSO: 4010/2004

NATIONAL DEVELOPMENTS

HEBEI SCIENCE AND TECHNOLOGY CONGRESS

Congress Opens

SK030430 Shijiazhuang HEBEI RIBAO in Chinese 15 Nov 86 p 1

[Excerpts] The Third Congress of the Provincial Scientific and Technological Association which the scientific and technological workers throughout the province had expected for a long time ceremoniously opened in Shijiazhuang on 14 November.

Some 518 delegates and 97 specially invited delegates of 22 delegations from various localities throughout the province happily gathered together under the same roof.

Comrade Wang Jian addressed the opening. On behalf of the provincial party committee and government, Li Wenshan, deputy secretary of the provincial party committee, extended warm congratulations to all delegates to the congress, and through them extended cordial regards to all scientists, as well as scientific and technological workers on all fronts throughout the province.

Wang Shuntong, honorary member of the China Association for Science and Technology and former vice chairman of the association, gave a congratulatory speech on behalf of the China Association for Science and Technology.

Representatives from the provincial Trade Union Council, the provincial CYL Committee, the provincial Women's Federation, the provincial Federation of Overseas Chinese, the provincial Federation of Social Sciences Societies, and the provincial Military District attended the congress to extend congratulations.

On behalf of the second committee of the provincial Scientific and Technological Association, Comrade Pu Junquan gave a report to the congress entitled "Work in Unity, Participate in Reform, and Contribute Our Wisdom and Ability to the Building of Two Civilizations in Our Province." The first part of the report reviews the work of the provincial Scientific and Technological Association since its second congress. He said: Since the convocation of the second congress of the provincial Scientific and Technological Association in May 1981, under the leadership of the party committees at all levels, the scientific and technological associations at all levels have mobilized the broad masses of

scientists and scientific and technological workers to adhere to the correct orientation of closely combining science and technology with economic construction, to actively participate in socialist modernization and reform, and to make remarkable achievements in building the two civilizations. Science organizations have gradually developed, and the number of county-level science associations has increased from 119 to 140. The number of provincial-level societies has increased from 61 to 101; that of the prefectural- and city-level societies has increased from 305 to 644; and that of the country-level societies has reached 1,689. The science popularization societies in various townships and towns have a total of 300,000 members, and the science associations of various plants and mining enterprises have a total of 38,000 members. Over the past 5 years, scientific and technological associations at all levels have sponsored 180,000 training classes of all descriptions and trained 9.5 million people. Great breakthroughs have been made in the rural scientific and technological training work. We have built 2,317 agricultural technical schools in townships and trained 152 persons. Regarding the training of middle school students in townships, we have sponsored over the past 2 years some 83,000 training classes and organized some 34,000 scientific and technological personnel to give lectures in the rural areas, and some 50,000 local experts and skilled workers to pass on their skills to the people. More than 5 million middle school students in the rural areas have mastered one or two practical skills and nearly one-third of the rural people have opened up new production avenues. Over the past few years, the scientific and technological associations and societies at all levels have established 130 consulting organs and extensively carried out activities to render scientific and technological consulting services. The scientific and technological workers have proposed a total of 84,000 suggestions to leaders at all levels, of which some 30,000 suggestions have been adopted.

The second part of Comrade Pu Junquan's report concerns the major tasks for the coming 5 years. He said: In the coming 5 years, the major tasks of the scientific and technological associations are to extensively carry out academic exchange, to enrich the academic ideology, to promote scientific progress, and to serve the economic construction; to popularize scientific and technological knowledge, to promote the building of spiritual civilization, to provide intellectual support for the building of the material civilization; to actively develop scientific and technological consulting undertakings, and to create greater social and economic benefits; and to promote democracy, to strengthen unity, and to do a better job in building "homes for scientific and technological workers."

The main items on the congress agenda are to discuss the work reports of the members, to adopt the "regulations of the Hebei Provincial Scientific and Technological Association," to offer plans and suggestions for the province's reform and the building of the two civilizations, and to elect the third committee of the Hebei Provincial Scientific and Technological Association.

Today, sitting on the rostrum were 27 representatives of the scientific and technological workers including Wang Jian, Wei Jiansun, Shen Qingrong, and Wei Ya.

Also sitting on the rostrum were leading comrades of the provincial Party Committee, the provincial Advisory Commission, the provincial People's Congress Standing Committee, the provincial government, and the provincial CPPCC Committee, including Xing Chongzhi, Xie Feng, Li Wenshan, Lu Chuanzan, Yang Zejiang, Yin Zhe, Want Zheng, Qu Weizhen, Liu Ronghui, Li Feng, Wang Youhui, and Du Jingyi.

Official Speaks at Congress

SK040045 Shijiazhuang HEBEI RIBAO in Chinese 15 Nov 86 p 1

[Speech by Li Wenshan, deputy secretary of the Hebei Provincial Party Committee, at the Third Congress of the Hebei provincial Scientific and Technological Association on 14 November]

[Excerpts] Deputies, Comrades:

The Third Congress of the Hebei Provincial S&T Association has ceremoniously opened today.

During the Sixth 5-Year Plan, Hebei scored more than 2,000 scientific research achievements at and above the provincial level, of which more than 300 reached the advanced domestic level, 1,035 won prizes issued by the state, ministries, and the province, and 35 won the state's invention awards. It also achieved notable results in developing the Taihang Shan mountainous areas by relying on S&T and in training rural senior and junior middle school graduates with practical skills and was encouraged by the State Council and relevant central departments. Over the past 5 years or more, S&T associations at various levels throughout the province have carried out active work for a definite orientation and, with the aim of developing the province's economic construction, have organized the masses of S&T workers to conduct extensive academic exchanges, actively participated in consultation and decisionmaking for development and reform in various fields, strove to expand lateral cooperation, and exerted great efforts to popularize S&T.

Viewing the overall situation of our nation, our province lags behind in terms of its S&T. So, we must pay full attention to this. The provincial Party Committee and government have set forth that our province should basically make its S&T system suit the requirements for the development of the commodity economy and the new economic system by 1990. Therefore, we should increase the funds for scientific research and continue to improve the equipment and conditions of scientific research institutions in an effort to have some research findings reach domestic and international advanced levels and to cultivate 600,000 scientific and technological experts of various categories and of various levels.

S&T associations should play a role in helping the party and government keep in touch with scientific and technological workers and should play a role as an assistant in developing S&T undertakings. Scientific and technological associations should especially play a key role in promoting S&T progress. No other organizations will be able to take their place. The party and government at

all levels should understand the key position of S&T associations by approaching them from the high plane of the overall modernization situation, and pay attention to and support the work of S&T associations. Simultaneously, the S&T associations at all levels should act according to the limits of their authority, work independently and creatively, and organize the vast number of scientific and technological workers to make great contributions to modernization.

We Should Resolutely and Steadily Promote the Reform of the S&T System in Order to Better Serve Hebei's Economic Construction

The reform of the S&T system is of decisive significance to develop scientific and technological undertakings. Party committees and the government at all levels, and all relevant departments should like the reform of the S&T system with that of the economic system, make overall arrangements for making the two systems reforms promote each other, and strive to basically put our province's S&T system on a new path during the Seventh 5-Year Plan period. While continuing to reform the system of financial allocation and carrying out the system of inviting specialized technicians, in 1987, we should focus on promoting lateral cooperation between scientific research institutions and the enterprises. We should vigorously disseminate the experiences gained by the Hebei Agricultural University in carrying out the work of coordinating teaching and scientific research with production and in comprehensively developing the Taihang Shan area in an effort to greatly develop various categories of associations linking scientific research with production.

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CSO: 4008/2027

NATIONAL DEVELOPMENTS

GUANGXI EMPHASIZES TRAINING SCIENTISTS, TECHNICIANS

HK190354 Nanning Guangxi Regional Service in Mandarin 1100 GMT 17 Nov 86

[Excerpts] Over the past 5 years and more, the region totally trained more than 30,000 scientists and technicians in various forms. Therefore, the quality of many scientists and technicians improved, and they made new contributions in the course of the four modernizations.

Science and technology in contemporary times develops rapidly, thereby making the process of updating knowledge of scientists and technicians more important. The region's contingent of scientists and technicians was weak in strength. Many people still equipped themselves with outdated knowledge. Therefore, it became particularly significant and urgent that we should continue to educate our scientists and technicians.

For this reason, the regional party committee and people's government urged all prefectures and cities to promptly perfect institutions for training scientists and technicians, in addition to allocating 5 million yuan for constructing the region's scientific and technological center. They also formulated specific regulations on the issue of educating scientists and technicians.

Now, Nanning, Liuzhou, Guilin, Wuzhou and Beihai cities have formed schools and studies centers for scientific and technological cadres. The economic and public health research institutes directly under the provincial organs, as well as the regional scientific research institute, have also established scientists' and technicians' institutes for higher learning, and training centers. There are also nine workers' institutes for higher learning, as well as a number of institutes for higher learning, which undertake some responsibility for educating scientists and technicians.

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CSO: 4008/2027

NATIONAL DEVELOPMENTS

SINO-FOREIGN COLLABORATIVE RESEARCH REGULATIONS TO BE DRAWN UP

OW221400 Beijing XINHUA in English 1030 GMT 22 Nov 86

[Text] Beijing, 22 Nov (XINHUA)--China plans to draw up and promulgate regulations on Sino-foreign collaborative research in science and technology in the next five years, Duan Ruichun, deputy director of the policy department of the State Science and Technology Commission (SSTC), told XINHUA today.

To further scientific and technical cooperation and exchanges with foreign countries, China is also considering drafting a series of laws and regulations on such issues as the management of technology import and export, and the application of laws in international cooperation on science and technology, Duan said.

Recent years have seen a boom in Sino-foreign scientific and technical exchanges and cooperation. So far, China has developed exchanges and cooperative relations with 106 countries and regions, according to statistics provided by the SSTC.

Last April, China enforced its first patent law to protect the interests of both sides involved in Sino-foreign cooperation in science and technology.

Since then, 47 foreign countries have applied for 8,900 patents in China.

"With further implementation of the open policy, a great increase in scientific and technical cooperation between China and foreign countries is expected in the near future," said Duan. "This creates an urgent need for a series of laws and regulations in this field."

Meanwhile, China is creating more favorable conditions for expanding Sino-foreign cooperation in science and technology, according to Wu Yikang, director of the SSTC's International Cooperation Department.

Some key state laboratories will be opened to foreign scientists and scholars to facilitate collaborative research. For example, the Chinese Academy of Sciences is to open 50 laboratories to its foreign counterparts, and some of them will be managed by noted foreign professors and scientists.

A group of Chinese specialists in cybernetics are conducting special research on the environment of international cooperation in the year 2000. This includes such topics as China's requirements for international cooperation, the impact of China's economic and trade development on scientific and technical cooperation, international political relations in the future, main scientific research items of developed countries and some international institutions, and the trends of development of international scientific and technical cooperation, said Wu.

In September, foreign scientific and technical officials stationed in China were introduced to China's first white paper on science and technology -- a guide to China's policy on science and technology. Wu revealed that China will issue its white book on science and technology every year.

Also, China will host or participate in more international exhibitions of science and technology in foreign countries to introduce China's scientific and technical achievements to the outside world, Wu said.

China will encourage and finance more scientists and scholars to take part in international academic activities and international or foreign academic institutions, Wu added.

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CSO: 4008/2021

NATIONAL DEVELOPMENTS

SSTC ON EXPANDED FOREIGN COOPERATION

OW211257 Beijing XINHUA in English 1233 GMT 21 Nov 86

[Text] Beijing, 21 Nov (XINHUA)--China has developed exchange and cooperation with 106 countries and regions in science and technology, according to an official of the State Science and Technology Commission [SSTC].

"With the policy of opening to the outside world, China has opened many new channels to increase scientific and technological exchange and cooperation with foreign countries," said Wu Yikang, director of SSTC's Department of International Cooperation.

"Great progress has been achieved in the scale and depth of Sino-foreign scientific and technological exchange and cooperation," Wu said.

"China has signed governmental and departmental agreements for scientific and technological cooperation in economics and trade with 54 countries," according to Wu.

"Exchange and cooperation on non-governmental levels has also peaked in recent years," said Wu.

So far, the Chinese Academy of Science and its affiliated research institutes have reached more than 70 agreements with international academic institutions, scientific research organizations, colleges, and universities in over 50 countries.

The China Science and Technology Exchange Center has sealed long-term agreements on scientific and technological exchange with 32 institutions abroad, and it has also established relations with more than 100 institutions in about 20 countries.

Since 1984, the Chinese association for Science and Technology has hosted 118 international academic conferences in China.

In the same period, China has sent about 15,000 delegations abroad to take part in various activities of international scientific and technological exchange. This amounts to five-fold that during the period of 1981 to 1983.

China has also been actively developing multilateral scientific and technological exchange and cooperation. So far, China has participated in more than 30 organizations of science and technology under the United Nations, and about 220 inter-governmental and civil academic organizations in the world, according to Wu.

"New forms have been developed in scientific and technological exchange and cooperation with foreign countries," Wu said, adding that China has collaborated with France in the high-tech field of developing multi-functional platforms for earth resource satellites.

A communication experiment by satellite has been conducted by China and Italy, and China is jointly operating a biological laboratory with the Federal Republic of Germany in Shanghai, and a high science and technology center with the world laboratory in Beijing. China has also teamed up with the U.S., Japan and the Federal Republic of Germany in exploring mineral resources in China.

"China has benefitted a lot from scientific and technological exchange and cooperation with foreign countries," said Wu.

"Advanced ideas, managerial experience, technology and equipment introduced from abroad have played an active role in improving China's science and technology. It has also contributed a lot to sharpen our scientific research skills and promote the export of Chinese advanced technology to other countries," he said.

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CSO: 4008/2021

NATIONAL DEVELOPMENTS

HANGZHOU'S S&T SITUATION DISCUSSED

OW100920 Beijing XINHUA in English 0840 GMT 10 Nov 86

[Text] Hangzhou, 10 Nov (XINHUA)--Scientists and technical personnel in Hangzhou are participating in making municipal policies, "providing a scientific basis for our policymaking," according to Zhong Boxi, mayor of the city.

"Scientists have actively launched strategic research and discussions on economic construction and social development," he explained. "They offer consultancy services, thus providing a scientific basis for our policymaking."

Hangzhou, now has 61 scientific and technological associations and research societies with scientists and technical personnel numbering 22,000.

Scientists in the city began to conduct diversified research to provide scientific consultancy services for city government leaders in 1983, and achieved remarkable success.

The Chinese government has for a time been stressing "democratic and scientific policy decision-making." Earlier this year, Vice-premier Wan Li said at a national conference that every leading department ought to have a decision-making research group to rely on. It should also give full scope to and rely on the role of decision-making researchers able to make penetrating judgments.

Scientists and technical personnel in many cities in the country are now encouraged to participate in policymaking. Said a scientists in Hangzhou: "Scientific policymaking is one aspect of scientific leadership. We are ready to provide consultancy for policymakers, linking academic studies directly with economic construction and social developments."

An official at the municipal scientific association said that scientists had also assessed the economic value of developing and utilizing the marine resources of three rivers around the city.

"Providing scientific bases for policymaking has inestimable ecological, social and economic benefits," the official noted.

In June 1985, more than 70 scientists from across the country gathered in Hangzhou to discuss the overall city construction plan. They offered constructive suggestions on issues such as city administration, economy, transportation, tourism and the size of the city; most of them were adopted by the city policy makers and implemented.

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CSO: 4008/2021

NATIONAL DEVELOPMENTS

NEW FISCAL SYSTEM FOR SCIENCE TO COME INTO FORCE

OW121044 Beijing XINHUA Domestic Service in Chinese 0750 GMT 11 Dec 86

[By reporter Zhuo Peirong]

[Excerpts] Beijing, 11 Dec (XINHUA)--Scientific research institutions across the country will practice a new fiscal system on a trial basis as of January 1987, according to members of the State Science and Technology Commission and the Ministry of Finance. The draft of the new fiscal system is now under final revision.

Two fiscal systems are practiced in our country: One for enterprises and the other for administrative units and institutions. In the past, most of the funds for scientific research institutions were appropriated by the state, and their financial activities were limited only to "drawing money from their funds, spending, and submitting a spending account." This is why scientific research institutions have practiced the fiscal system for administrative units and institutions. With the reform of the science and technology management system over the past few years, however, technological achievements have begun to enter the market as a commodity, and the value of scientists' and technicians' labor results from market exchange. So scientific research institutions no longer rely entirely on state appropriations for their survival; changes have taken place in their financial activities and methods of business accounting. The old fiscal system is therefore no longer suitable for them.

Members of the State Science and Technology Commission and the Ministry of Finance hold that trial implementation of this fiscal system will make it possible to protect lawfully earned incomes of scientific research institutions and to bring their funds under macroeconomic control.

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CSO: 4008/2038

NATIONAL DEVELOPMENTS

CITIC OPENS NEW TECHNOLOGY DEVELOPMENT DEPARTMENT

OW111321 Beijing XINHUA in English 0916 GMT 11 Oct 86

[Text] Beijing, 11 Oct (XINHUA)--The China International Trust and Investment Corporation [CITIC] has opened a new department for the development of new and high technology.

According to a CITIC official, the new department is responsible for developing, utilizing and popularizing new and high technology, as well as providing investment for blazing new trails in new and high technology development.

"The new move is aimed at putting scientific findings into practical use in developing the country's commodity economy, Ma Jilong, the director of the new department told XINHUA.

"Disintegration of technological and economic development has been one of the serious problems facing the country's modernization drive," he added.

CITIC has already undertaken importing new technology, Ma said, citing the Sino-American Biotechnology Company established with the help of CITIC.

As a joint venture of the American Promega Biotech Corporation and a biotech factory in Luoyang, Henan Province, the company will begin to produce various enzymes.

CITIC, with Rong Yiren, vice-chairman of the National People's Congress standing committee, as chairman of the board of directors, has had monetary and trade relations with the United States, Canada, Japan, Australia, Western Europe and Asian countries. The number of projects and agreements involving CITIC investment has amounted to 160.

CITIC is ready to play its dual role in developing new technology and enhancing links with foreign scientific and business circles so as to advance the country's economy.

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CSO: 4008/2021

NATIONAL DEVELOPMENTS

ROTOR-FORGING TECHNOLOGY PASSES STATE TASTE

OW101050 Beijing XINHUA in English 0717 GMT 10 Nov 86

[Text] Shanghai, 10 Nov (XINHUA)--China's power-station industry received a valuable boost as domestic technology for producing the rotor forging for a 300,000-kilowatt generator passed rigid state technical tests Sunday in Shanghai.

"China's success in manufacturing the rotor forging has created a new way of producing large forge pieces and will speed up the development of the country's power station equipment-making industry," said Lin Zongtang, deputy head of the State Key Technology and Equipment Advisory Group under the State Council, speaking at the test-appraisal meeting.

"Though China is capable of manufacturing complete sets of power stations, the rotor forging, a key part in building power stations, was long imported from other countries," said Lin, also vice-minister of the State Economic Commission.

The rotor forging piece was designed and produced by a heavy machine tool plant in Shanghai, using a Chinese-made electroslog remelting furnace. Its strength, plasticity, tenacity and fatigue strength satisfy state design standards, said an expert who attended the appraisal meeting.

The 200-ton furnace, built in 1980, is said to be the biggest in the world. So far it has forged a total of 32 huge steel slabs, ranging between 85 and 205 tons. The 124 pieces it forged for China's first nuclear power station have met technical requirements, a plant official said.

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CSO: 4008/2021

NATIONAL DEVELOPMENTS

INSTRUMENTAL ANALYSIS ASSOCIATION FORMED

OW122202 Beijing XINHUA in English 1623 GMT 12 Dec 86

[Text] Beijing, 12 Dec (XINHUA)--China Association on Instrumental Analysis (CAIA), composed of 87 organizations of similar nature of the country, was established here today.

"The association is to serve the needs of the country's scientific and technological research, economic and social construction. Its service is to be especially extended to the undertakings of agriculture, forestry, animal husbandry, fishery and rural construction as well as industrial production and construction, and rural enterprises," said Yang Jun, president of the association, who is also a former vice-minister of the State Science Commission. He said, the association's routine work will include sponsoring activities of technical, managerial and training exchange and coordination in the aspect of instrumental analysis. It will also sponsor seminars on instrumental analysis and relevant exhibitions. Besides, the association will take up the tasks entrusted by the government and give consultations at its request.

Yang Jun said that the association will make efforts to establish contacts with its foreign counterparts, organizing international exchange and coordination in the field of instrumental analysis.

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CSO: 4010/2040

NATIONAL DEVELOPMENTS

HUBEI TECHNOLOGICAL TRANSFORMATION INVESTMENT CONTROLLED

HK251404 Wuhan Hubei Provincial Service in Mandarin 1100 GMT 24 Nov 86

[Text] The investigation of the technical transformation items of the whole province this year, which was conducted by provincial departments concerned, reveals that the scale of technical innovation and transformation investment of our province has been effectively controlled. At present, the units of our province which are under the ownership of the whole people are carrying out 822 technical transformation items. According to the plan, the amount of investment in technical innovation and transformation this year is 1.04 billion yuan. According to the present situation, it is estimated that the amount of investment by the end of this year will be some 850 million yuan. The scale of investment is controlled within the scale of innovation and transformation investment specified by the state.

This year, regarding technical innovation and transformation items, our province has taken such measures such as: linking localities with trades; not allowing investment in items to exceed capital; not allowing items not covered by the plan to be carried out; and carrying out all technical transformation items within the amount of investment, thus effectively controlling the scale of innovation and transformation investment.

In the course of this investigation, provincial departments concerned suspended and delayed some capital construction projects, projects for which sufficient preliminary preparations were not made, and duplicated projects and reduced the amount of irrational investment by some 110 million yuan, so that the investment in technical transformation items this year is rational and the construction of key projects is guaranteed.

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CSO: 4008/2038

SHENZHEN ESTABLISHES EXPERT PANEL TO REVIEW IMPORTS

Beijing RENMIN RIBAO in Chinese 4 Oct 86 p 3

[Article by Wang Yougong [3769 0645 1872]: "Shenzhen's Technology Imports Now Must Be Approved by Experts: If the New Appraisal Commission Passes Negative Judgment on a Project, Review Departments in Principle May Not Grant Approval"]

[Text] The Shenzhen Technology Import Advisory and Appraisal Commission was formally established 29 September to help the city government import good technology.

Technological import work, a key link in the Shenzhen Special Economic Zone's program of opening up to the outside world, has advanced in recent years. Nevertheless, the zone's inexperience has made such problems as insufficient proof of feasibility and blind and redundant importing unavoidable. Improvement in the approval system and in the quality of technological imports, therefore, have become top priorities in the zone's import work. Thus the city government appointed 38 expert engineer specialists to form a semi-official, nonprofit and authoritative technological appraisal and consultative agency. At government request, this agency will provide advice on general technological development planning; produce evaluations of the degree of advancement, applicability and economy of technological imports; submit various appraisals to approval departments for reference; and make suggestions on how to absorb, adapt, develop and make new innovations with the technology and equipment imported by enterprises.

The Shenzhen City government has ordered that all important technology imported by the SEZ must be reviewed by this brain trust and that, if the commission passes negative judgment on an import, approval departments in principle may not grant approval.

The commission has already submitted evaluations of 10-plus technological imports. These reports not only appraised the degree of advancement, feasibility and economy of those imports but also suggested revisions of agreements in which start-up costs were too high and contracts were too long and of such matters as the amounts of stock shares apportioned in return for technology transfers, grants of preferential treatment and property rights.

12431

CSO: 4006/68

NATIONAL DEVELOPMENTS

EFFORTS TO CURB MACHINERY IMPORT DUPLICATION

Beijing RENMIN RIBAO in Chinese 24 Nov 86 p 2

[Article by Wang Qixing [3769 0796 2502] and Li Xiaolin [2621 1420 2651]: "How Two Dalian Enterprises Avoided Import Duplication"]

[Text] Just about everybody agrees that import duplication is one of the major weaknesses in China's technology import today. However, all we have been doing in recent years is to shout "Stop!" without actually doing anything to stop it. Lately, though, two Dalian enterprises have flashed the "red light" at import duplication. They are the Dalian Port Affairs Bureau and Dalian Hoisting Machinery Plant.

A Difficult Choice

To solve the problem of insufficient loading capacity at Dalian's container berths, the government early this year authorized Dalian to import some hoisting equipment, for which it had allocated \$3.8 million. After word got out, 11 well-known companies from the U.S., Federal Republic of Germany, Finland, and Japan flocked to China. Foreign exchange in hand, Director Wang Diandong [3769 3013 2767] and chief engineer Pu Lisheng [3184 0632 3932] had to do some hard thinking. They were faced with two alternatives: one, simply buy the equipment overseas, an easy, familiar course of action that would save them a good deal of work; and two, combine technology with trade by purchasing the essential equipment as well as technology and disseminating the software among domestic producers. This would bring closer the day when China can produce the hardware on its own, but also carries considerable risks.

The Dalian Port Affairs Bureau chose the latter. Following detailed thorough feasibility studies, it approached Dalian Hoisting Machinery Plant with the proposal to combine technology with trade. Under this proposal, software would be imported for the plant to facilitate technical transformation even as some equipment was purchased from abroad.

This strategic decision was exactly what the Dalian Hoisting Machinery Plant wanted. It is a leading, high-powered enterprise in China's crane manufacturing industry. The spectacle of foreigners jockeying for position in the China market was not calculated to please Li Mingchang [2621 2494 7022],

the plant director. With his many years of experience, he believed that China is entirely capable of producing modern hoisting equipment provided the essential technology and parts are secured overseas. He was only too glad that the Dalian Port Affairs Bureau offered him this opportunity.

The shore was all calm and serene in early spring. But competition had never been more ferocious in the building housing the Port Affairs Bureau. As equipment supplier for the port, the Dalian plant was locked in a cut-throat struggle with 11 foreign firms, negotiating and quoting prices endlessly. One foreign company slashed prices time and again without blinking an eye, but refused to budge when it came to technology transfer. Faced with this tough situation, the plant was determined to fight to the finish. In the end, it was awarded the project by offering lower prices than that company's and cooperating with Paixike Company of the U.S., which was willing to supply the essential technology and parts.

Breaking Through the Blockade

Horizontal linkages between users and producers, integration between trade and technology, and technology import work to the clear advantage of both parties. After it won the bid, Dalian Hoisting Machinery Plant obtained the design and manufacturing technology of containerized cranes, which was almost all of a high standard. Meanwhile, the Port Affairs Bureau was able to buy an extra most expensive container loading bridge with the foreign exchange thus saved.

But why did not good things like this, "hard to find even with a lighted lantern," occur more often in the past? The crux of the problem was fragmentation and a management system that stressed departmental proprietorship, resulting in an invisible blockade between departments and enterprises. What is remarkable about the leaders of the two Dalian enterprises was their courage to transcend "self-interests" and, fired by a strong sense of reform, strike at the blockade of the old system.

Early in the year, when Dalian approached Dalian Hoisting Machinery Plant on its own initiative, Li Mingchang's pleasure was tempered by some misgivings: the plant did not have the foreign exchange to pay the "software fee." Accordingly Pu Lisheng, the chief engineer, proposed that the bureau give the plant \$400,000 to pay the "software fee." Some people in the bureau did not agree. Wasn't this the same as benefiting others without benefiting oneself? Director Wang Diandong, however, was strongly supportive of Pu Lisheng. In the meantime, Li Mingchang's office was overflowing with people trying to kill the idea. Some contended that since the plant's two award-winning products were its "money trees" with an industry-wide reputation, to neglect them and "fool around with" containers was to "ask for trouble." In Li Mingchang's opinion, however, the construction of China's four major ports--Tianjin, Shanghai, Guangzhou, and Dalian--in the Seventh 5-Year Plan would require at least over 100 pieces of hoisting equipment. Once the Dalian plant imports technology and starts turning out Chinese-made equipment, import duplication can be avoided in the future, saving the government hundreds of thousands of yuan in foreign exchange. This is no different than laying a "golden egg" for the country.

Thinking and Searching

By rising above "self-interests," Dalian Port Affairs Bureau and Dalian Hoisting Machinery Plant turned on the "red light" for import duplication. Meanwhile, however, another unit in the same region gave the "green light" for import duplication. Cooperating with foreigners, Dalian Heavy Machinery Plant has been producing heavy-duty coal transporting equipment over the past few years for such key national projects as Qinhuangdao and Shijiusuogang. Yet a major project that went under way recently in Dalian ordered similar equipment overseas. The strange thing is that when the foreign company offered to enter into cooperative production with Dalian Heavy Machinery, it was turned down by the buyer. The result is that we failed to obtain a piece of technology that could have been obtained and earn the over \$2 million that could have been earned.

How to unite divided forces? Everybody in Dalian, from top to bottom, has been thinking and searching. The Japanese government adopted an effective method that has kept the ratio between imported technology and imported equipment at 9:1. And in no time Japan overtook the U.S. and Europe. Can we apply suitable administrative and economic tools to mobilize enterprises' enthusiasm for importing technology while holding in check their blind import duplication?

When all is said and done, however, these are mere tools. It is institutions where national and enterprise interests, where long-term and immediate interests, meet. As someone has commented, "The two Dalian enterprises have flashed the 'red light' not only at import duplication, but also at a fragmented economic system."

12581

CSO: 4006/141

NATIONAL DEVELOPMENTS

UPSURGE IN TECHNOLOGY IMPORTS, ENTERPRISE TRANSFORMATION

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 4 Dec 86 p 3

[Article by Jiang Shaogao [3068 4801 7559]: "3,000 Pieces of Technology Imported in 3 Years"]

[Text] Of the "3,000 pieces" of advanced technology imported in the last 3 years of the Sixth 5-Year Plan, about 60 percent will be put into production by the end of this year, to be joined by the remainder in the next 2 years. These projects will be a vital force in the development of the national economy and play a crucial role in the Seventh 5-Year Plan.

For 30 years after the People's Republic was founded, the nation's major mode of technology import was to purchase complete sets of large-scale equipment, build new plants and go in for extensive development. In 1982, the State Council demanded that we import technology and transform existing enterprises without delay, put forward a plan calling for the import of 3,000 pieces of advanced technology in the last 3 years of the Sixth 5-Year Plan to transform existing enterprises, and asked the Economic Planning Council to see that each project was carried out. As of late 1985, contracts were actually signed with foreigners on 3,900 projects. Propelled by the "3,000 projects," China experienced its first upsurge in technology import and technical transformation. Over the past few years, all industries have integrated technical transformation with the import of essential technology and equipment. Characteristically, these projects require limited outlays, have a short construction period, pay off quickly, and yield good economic results.

The "3,000 projects" have enabled some Chinese industries and products to leap-frog technically, significantly narrowing the gap with advanced nations. Ten percent of the products of the machinery industry today reach international standards of the late 1970's and early 1980's. In electronics, the manufacturing of color TV sets, video cassette recorders, recorders, and copiers has grown and matured. More than 30 percent of electronic products are now on a par with the best in the world in the late 1970's and early 1980's, up from 15 percent in 1982. The technical levels of such industries as metallurgy and those that make food, knitwear, daily consumer goods, and power plant equipment have also changed appreciably.

Technology import and the technical transformation of enterprises have improved China's product competitiveness in the international marketplace and promoted exports. After spending \$3.26 million on the import of five silk printing production lines, a silk company boosted exports by 10 million meters of real printed silk, earning an additional \$50 million in foreign exchange.

12581

CSO: 4006/163

NATIONAL DEVELOPMENTS

INDUSTRIAL TECHNOLOGY EXPORTS ENCOURAGED

OW200551 Beijing Domestic Service in Mandarin 0900 17 Nov 86

[Text] According to a "JINGJI CANKAO [ECONOMIC REFERENCE]" report, the State Council recently has given written instructions about a report on technology exports, submitted by the Ministry of Foreign Economic Relations and Trade and the State Scientific and Technological Commission.

In its instructions, the State Council called on the departments concerned to take necessary measures to encourage technology exports after improving overall management and harmonizing relations between various quarters.

The Ministry of Foreign Economic Relations and Trade and the State Science and Technology Commission pointed out in the report: We should stress industrial technology in our technology exports. We have many technologies of this category, and the time for exporting them is ripe. Moreover, their export will promote that of more industrial products. We should encourage the export of these technologies as long as it does not hurt our national security and major economic and political interests, and does not adversely affect our export commodity market. However, we should assume a prudent attitude to the export of laboratory techniques, new scientific research findings, and new inventions. We should consider the confidentiality of the new techniques, while taking into account the possibility of domestic development. In principle, we should first develop technology at home, if we can develop it there, turn it into industrial products for export, and protect its confidentiality. In order to protect export technologies, we should apply for patents abroad in good time for those technologies qualified for patenting. We should sign contracts as the primary way to protect our exclusive technologies and technological secrets.

On the procedures for examining and approving technology export requests, the report proposed that they be handled by the departments in charge at various levels, and submitted to higher authority through the command channel.

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CSO: 4010/2003

NATIONAL DEVELOPMENTS

SATELLITE LAUNCHING, EMPLOYMENT PLANS REVEALED

HK200635 Hong Kong ZHONGGUO XINWEN SHE in Chinese 1314 GMT 19 Nov 86

[Article by Zin Lang [4440 2597]: "China Develops a series of earth observation satellites" -- ZHONGGUO XINWEN SHE HEADLINE]

[Text] Beijing, 19 Nov (ZHONGGUO XINWEN SHE) -- A veteran aeronautics industry expert revealed today that China has begun developing a series of satellites to observe the earth, and the plan's progress has been very smooth.

Wang Xiji [3769 1585 1323], chairman of the Scientific and Technological Committee under the Chinese Academy of Space Technology, said that the earth observation satellites would include some for a general survey of Chinese territory, as well as others to observe the weather, oceans and earth's resources. China has already launched the general survey, scientific exploration, and technological experiment satellites. It will launch a weather satellite soon, and an earth resources observation satellite is under development. The parties concerned are discussing and testing the maritime satellite. Development of this series of satellites will promote China's progress in aeronautics and remote sensing undertakings.

China launched its first earth satellite in 1970. Over the past 16 years, China has sent 19 satellites into space. Wang Xiji said: An absolute majority of these satellites are undertaking tasks of remote sensing on the earth.

China's aeronautics and remote sensing technology has been widely used in various fields of national economic development. The technology plays a very important role in general territorial surveys, geological exploration, irrigation works, city planning, and estimating agricultural production. Wang Xiji said that in future, China's aeronautics industry would strengthen international cooperation in aeronautics and remote sensing, to make contributions to man's peaceful use of outer space.

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CSO: 4010/2203

NATIONAL DEVELOPMENTS

'EXACT NUMBER' OF COMPUTERS RELEASED

HK250255 Hong Kong SOUTH CHINA MORNING POST in English 25 Nov 86 pp 1, 2

[Article by Albert Chan]

[Text] China will soon have regulations to control the prices, copyright and circulation of computer software on the mainland.

To carry this out, a national software registration and circulation centre will be set up.

This was disclosed by a top computer expert in China, Professor Guo Pingxin, who attended the Southeast Asian Regional Computer Conference held in Bangkok last week.

Other measures to encourage software development in China included a standardized system of assessing computer professionals and awarding credentials, said Professor Guo who is a trustee of the prestigious International Federation of Information Processing.

"Software personnel, regardless of their educational backgrounds, will be examined uniformly. Those who pass the examinations will be conferred the title of programmer or software engineer," he said.

In a paper presented at the conference, Professor Guo also revealed that China had 217,900 micro-computers and 3,891 mainframes and mini-computers.

It is the first time that China has released the exact number of computers installed and their applications.

It had been widely reported earlier that there were 130,000 micro-computers in China and half of them were idle or simply gathering dust in stores because many enterprises and government departments which purchased the machines did not know how to use them.

Distribution of installed mainframes
and minicomputers

Department	Quantity installed
Oil	164
Chemical engineering	51
Water conservancy and power	174
Metallurgy	249
Railway	114
Traffic	43
Coal	43
Agriculture and forestry	21
Light industry	73
Textile	109
Posts and telecommunications	83
Architecture and architectural material	45
Machine	271
Nuclear industry	81
Aviation industry	179
Electronics industry	347
Meteorology	18
Conventional weapons	31
Shipbuilding	169
Space	111
Commercial Bank	95
Academy of science	219
Planning and statistics	28
Medicine and health	111
Colleges and universities	465
Geology	45
Earthquake	37
Computer centres	61
Culture and publishing	17
Ocean	24
Mapping	12
Others	329
TOTAL	3,819

A scandalous number of micro-computers was imported from 1983 to early 1985, until stringent curbs on imports and spending imposed by Beijing in March [1985] reduced this flow to a trickle.

The main problem in China's computer market has been the imbalance of the huge volume of imported or domestically-produced hardware and the scarcity of software needed to run the machines.

But following the recent establishment of the State Council's Leading Group of Electronics Development under Vice-Premier Mr Li Peng, "Policies for computer popularization and application have been set up," said Professor Guo.

The group's aim is to encourage software research and protect "new accomplishments in computer application", said Professor Guo.

"Development of application software is being encouraged. Regulations controlling software prices and circulation will be set up," he said.

He said although national policy was to introduce automation to traditional industries to improve efficiency and production, only enterprises which affected significantly the national economy--such as iron, steel and oil industries--would be chosen as "focal points of technical reformation".

Professor Guo spoke on computer application in almost every field on the mainland with one notable exception--military.

National Microcomputer Application in 1985
(total quantity installed - 217,900)

Scope of application	Quantity of projects	Percentage
Instrument and measurement	984	2.1 [as published]
Process control	662	21.6
Management	306	10.0
CAD, CAE, CAM	267	8.7
Software development	264	8.6
Medicine and health	173	5.6
Chinese character information processing	78	2.5
Optimisation and policy decision	42	1.3
Others	296	9.6
TOTAL	3,072	

/6662

CSO: 4010/1006

NATIONAL DEVELOPMENTS

BRIEFS

COMPUTER INDUSTRY TO EMPHASIZE SERVICE--Beijing, 4 Nov (XINHUA)--China's computer industry should emphasize service if it wants to grow over the next five years, a commentary in the ECONOMIC DAILY said today. The paper said the industry's output value was 1.7 billion yuan last year while earnings from its service were just 100 million yuan. Less than half of China's 130,000 microcomputers are being used, the paper said, and that the industry had an inventory of 20,000 unsold domestic computers at the end of 1985. In 1984, the paper said, China imported 70,000 computers as domestic manufacturers could not keep up with demand. But, it added, "Many offices that bought computers found they lacked the competence and the software to run them and the technical staff to maintain them." The paper said domestic computer manufacturers have developed reliable software and training and maintenance programs, and have undercut the prices of imported equipment. "But consumer dissatisfaction with computers generally has limited domestic sales," it said. "To regain markets, domestic manufacturers will have to focus their attention on the using of computers." [Text] [Beijing XINHUA in English 1032 GMT 4 Nov 86 OW] /6662

PLANS TO BUILD HIGH-EFFICIENCY COMPUTERS--Beijing, 26 Aug (XINHUA)--The Institute of Computing Technology of the Chinese Academy of Sciences will build high-efficiency computers in the next few years, a director of the institute Zeng Maochao told XINHUA here today. A mainframe computer capable of making 20 million calculations per second is expected to be put into operation in early 1988, he predicted. It will be in use in petroleum, geology and meteorological departments. In addition, he said, basic research on some other computers with even higher efficiency and on software items is also underway. As the cradle of Chinese computers, the institute built China's first computer two years after it was founded in 1956. Over the past 30 years, it has designed and manufactured more than 20 varieties of mainframe computers and microcomputers, thus making a big contribution to the development of China's sophisticated technology and the national economic construction. The director said that his institute has achieved much progress in computer-aided designing and manufacturing and in developing disk technology. A breakthrough has also been made in processing Chinese character information, he added. [Text] [Beijing XINHUA in English 0044 GMT 26 Aug 86 OW] /6662

SHANGHAI METAL PLATE BENDER--Beijing, 9 Oct (XINHUA)--A Shanghai factory succeeded in producing a 100-ton numerical-controlled metal plate bending and processing machine. The success was claimed to mark a new stage in China's production of metal plate bending and processing machines. The machine is comparable to similar products of the 1980s in the world. It is an indispensable machine tool for many industries including machine-building, aviation, space, light industry, and household electrical appliances. [Text] [Beijing XINHUA in English 0728 GMT 9 Oct 86 OW] /12624

CAS AID TO COMPANY--Beijing, 31 Oct (XINHUA)--Thanks to a crack research team from the Chinese Academy of Science [CAS], the Beijing-based Keli High-Tech Company has sold 30 million yuan US \$8.7 million in high-tech equipment. Since its conception two years ago, 100 company scientists and experts have accomplished 80 tasks, including designing a data-collection and analysis system, automatic facilities for offices and laboratories, a high-density visual system and an auxiliary design system for computers. With its own workshops and production lines, the company has greatly shortened the distance and time from the drafting board to the finished product. Production of a large-screen demonstrator system, which took up to two years previously, can now start after a few months. With its strong technical resources and CAS backing, the company has cooperated with other enterprises to attract more investment for its development. The company has also cooperated with eight foreign and Hong Kong companies to produce a dozen new products. [Excerpts] [Beijing XINHUA in English 1313 GMT 31 Oct 86 OW] /12624

TECHNOLOGICAL COOPERATION--Initiated in Shenyang in early 1960's, the activity of technological cooperation between Liaoning's workers and staff members made positive contributions to overcoming economic difficulties of the state and promoting the development of production in those years. Since the Third Plenum of the 11th CPC Central Committee, new progress has been made in the province's activity of technological cooperation between workers and staff members. According to statistics, at present our province has more than 5,800 technological cooperation organizations and more than 220,000 activists in technological cooperation. Since 1981, through technological cooperation, the province has solved more than 130,000 technological problems, which has increased output value by more than 1 billion yuan, and has implemented more than 660,000 reasonable suggestions and improved technologies, which has increased output value by more than 3.3 billion yuan. [Excerpts] [Shenyang Liaoning Provincial Service in Mandarin 1030 GMT 24 Oct 86 SK] /12624

S&T PRODUCTS FAIR--Zhengzhou, 21 Nov (XINHUA)--A 10 day national fair of applicable new techniques and new scientific and technological products closed in Zhengzhou on 20 November. The fair was cosponsored by science and technology centers, and by town, village, and private enterprises with new products or new techniques in various parts of China. During the fair, some 10,000 visitors discussed business deals and 224 contracts for deals amounting to 13,316,000 yuan were signed. Many of the deals were signed with town, village, and private enterprises which used to be overlooked. [Text] [Beijing XINHUA Domestic Service in Chinese 0812 GMT 21 Nov 86 OW] /12624

HUANG HE SURVEY--Beijing, 9 Dec (XINHUA)--A scientific survey of the sea areas near the Huang He mouth over the past two years has proved fruitful. According to the result of a survey jointly sponsored by the Shandong Oceanology College and its French counterpart, pollution from heavy metal and organic substances in the Huang He mouth is lower than in any other river in the world. A Sino-American survey in the area also discovered the phenomenon of seabed instability and recorded materials on the scope, feature, development patterns, marine deposit and silt movement of the delta bed. [Text] [Beijing XINHUA in English 1042 GMT 9 Dec 86 OW] /12624

SHAANXI CADRE, TECHNOLOGY EXCHANGE--The province is making constant progress in the exchange of talented people and technology. Since the beginning of last year, the province has received a total of 49,000 technical cadres, over 4,100 of whom have completed all required procedures for transfer. The province has signed a total of 151 technical contracts and agreements on transferring scientific and technological achievements with others. The provincial authorities have now established organs with 8 prefectures and cities, 17 counties, national defense departments, and building industry departments for exchanging talented people and technology. [Summary] [Xian Shaanxi Provincial Service in Mandarin 0100 GMT 30 Oct 86 HK] /12232

SHAANXI SPARK PLAN PROJECTS--Shaanxi is now smoothly implementing its first batch of 250 Spark Plan projects. The total investment in these projects is 80 million yuan. When the projects are completed, it is estimated that the province's output value will increase by 280 million yuan and tax and profit by 50 million yuan a year. All of these 250 technology development projects have been selected in light of the province's reality after discussion by the experts concerned. Most of them can be completed in 2 years. Eight of the 27 projects that are included in the state plan have already yielded economic results. One of these projects is the building of a chesnut production and processing base in Zhashui and Zhenan Counties. [Summary] [Xian Shaanxi Provincial Service in Mandarin 0030 GMT 4 Dec 86 HK] /12232

CS0: 4008/2027

DATA COLLECTION, PROCESS CONTROL SYSTEM DESCRIBED

Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 7, No 1, Jan 86 pp 1-8

[Article by Han Sunan [7281 5685 0589], Institute No 634, Ministry of the Aviation Industry: "Software Design for a Data Acquisition and Test Process Control System"]

[Text] The setting up of industrial (test) process control and data acquisition systems centered on microcomputers has become an extremely broad field for microcomputer applications. This kind of applications software should gradually become conventionalized, and there should be a set of procedures for developing software. For this reason, aside from discussing the software design for a particular real time applications system, this paper will also touch upon software development procedures (informal) that we have followed. These procedures includes: a description of the test demands, a description of the data and programs, realization of the program designs and their strategies, and the debugging of the software. These are then the titles of the sections of this paper. The software that has been realized also has a certain degree of universality.

This system has a computer at its core, and for peripheral equipment is equipped, in addition to a line printer, terminal, and disk drives, with an I/O subsystem that is exclusively for data acquisition and control. This subsystem has its own bus. The computer bus and subsystem bus are connected by means of a 16-bit parallel bus and control panel, as shown in figure 1.

The operating system for the computer is one that supports multitasking. The scheduling of tasks is of a first-priority-then-round-robin mode, that is, where first is run the task in the ready queue with the highest priority, and where tasks with equal priorities are run on round-robin scheduling, which ensures that each task will share the CPU. Modes of communication between the tasks primarily include: one task activating or terminating another; transmitting or receiving small amounts of information; setting or identifying (waiting) event markers, etc. Communication is done through system calls. The operating system also permits setting up resident shared areas in internal storage, which through relevant processing tasks may regard as their own space for optional access.

Programming languages that may be used include assembly language and at least one higher level language (as for example, FORTRAN).

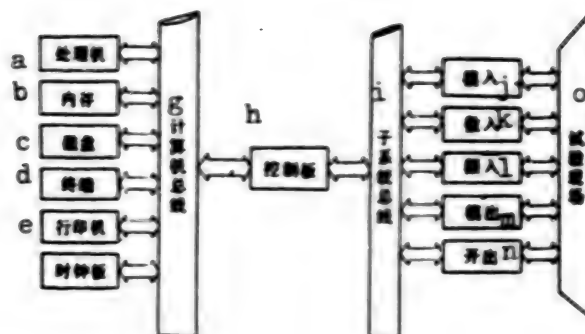


Figure 1. Hardware Environment

- Key:
- | | |
|---------------------|--------------------|
| a. CPU | i. subsystem bus |
| b. internal storage | j. analog input |
| c. disks | k. digital input |
| d. terminal | l. frequency input |
| e. line printer | m. analog output |
| f. clock board | n. switched output |
| g. computer bus | o. test fields |
| h. control panel | |

I. A Description of Test Requirements

This system is used for an ORE 360 hour test of a locomotive diesel engine (European International Railway Alliance standards). According to the test requirements, there are many things that must be controlled. To avoid clouding the narration of the theme here, we provide only the main items.

A. Various input/output channels

Based on test measurements and the objects of control, the system has the following input/output signals.

1. Analog quantity input, digital quantity input, frequency input

There are two kinds of digital quantities. One is an 8421 coded signal, where 1 group of 16 bits indicates a 4 place decimal value, which is called the digital quantity input (digital input). The other kind is a switched signal, where 16 bits are 1 group and where each bit is either "0" or "1," each having its own significance. By custom, this is called switched quantity input (switched input). Switched input is then divided into interrupt switched input and non-interrupt switched input, which signals are primarily used in indicating the occurrence of field events. Analog quantity input (analog input) and frequency quantity input (frequency input) are used to measure the frequencies of voltage and pulse signals, respectively, coming from (temperature, pressure) transducers. The objects represented by input signals include: various temperatures and pressures, rotation, of the diesel engine, diesel engine torque, fuel consumption, fluid flows and levels, etc.

2. Analog quantity output (analog output) and switched quantity output (switched output)

Analog and switched outputs are used primarily for diesel engine torque and rotation, the control of water and oil temperatures, and the switching of equipment and apparatus, as well as for warning of various abnormal conditions.

B. A Description of the Test Process

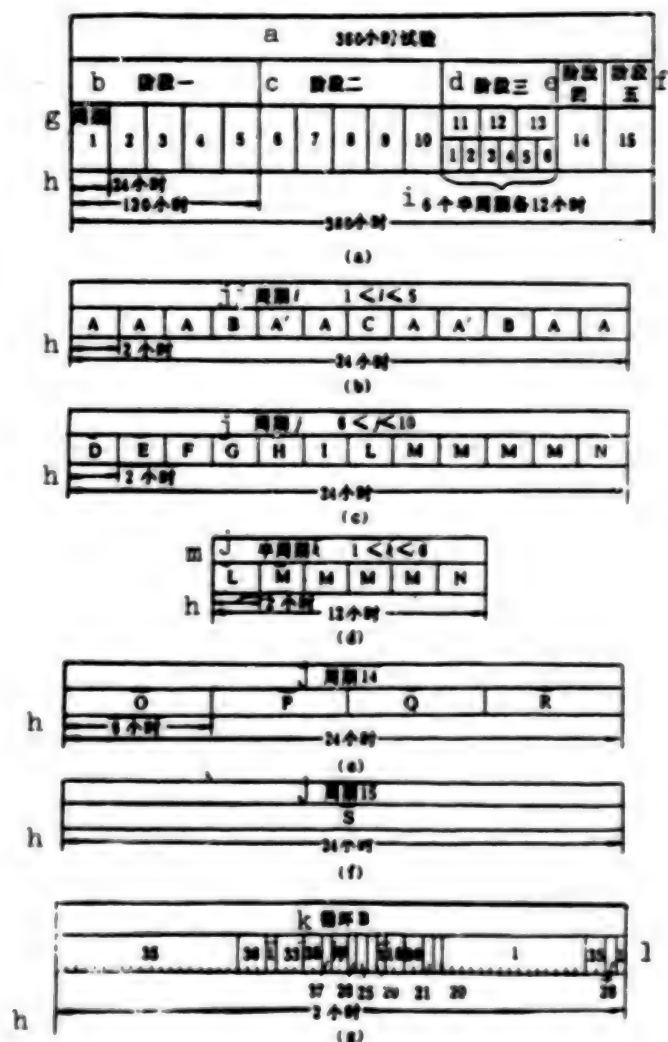


Figure 2. ORE 360 hour test process

- | | |
|-----------------|-------------------|
| a. 360 hr. test | h. hours |
| b. 1st stage | i. 6 half-periods |
| c. 2d stage | j. period |
| d. 3d stage | k. cycle |
| e. 4th stage | l. halt |
| f. 5th stage | m. half period |
| g. period | |

The entire test goes on for 360 hours, where each 120 hours constitutes an independent test process. The testing is done in five stages. The first and second stages run in succession for 120 hours each, while the third, fourth, and fifth stages run successively for a total of 120 hours. A stage is comprised of several time periods (half time periods), where each time period (half time period) has several cycles, the cycles being constructed of the fundamental states--working conditions, in the test. Figure 2 provides a diagram of a single test process. The cycles within are represented alphabetically.

The figures show only the structure of the operating conditions for cycle B, where the smallest unit is 2 minutes. When the cycles are not the same, the sequence of operating conditions contained therein are not similar either. By operating conditions is meant the diesel engine operating conditions, primary indicators for which are the two parameters of rotation and torque. The total of 44 operating conditions uses all numbers from 1 through 44 as indicators, which are then called operating condition numbers.

The diagram in figure 2 is actually showing a tree structure, which is called the "test tree." In this, the roots are the 360 hours of testing and the operating conditions are the leaves. The two branches that are stages 1 and 2 are completely similar in the structure.

C. A Description of Control and Data Acquisition

The work of the computer in testing is primarily in the following areas:

1. Time control for the entire test and the constituent parts thereof.
2. The test requires that after the engine has recovered from a stoppage it can continue running from the point of interrupt in the overall time scheme; it also requires that the test need not be in the sequence of cycles in figure 2, but can be run in a sequence of cycles arbitrarily formed.
3. The transition between operating conditions, that is, control of changes in rotation speed and torque. These two controls require an adjustment in speed of 7.5 percent of a standard operating condition (where rotation or torque is at 100 percent) each second. The torque herein is regulated by the PID closed-loop process control method.
4. To measure fuel consumption by measuring fuel consumption during a particular operating condition. Measures 5 times during this operating condition. The process is: during the measurement interval, the computer initiates a peripheral fuel measurement device. After the fuel measurement device has filled with fuel, it provides a "fuel start" interrupt to the computer, then after consumption of the fuel, it provides a "fuel stop" interrupt to the computer. The computer marks the times for the two interrupts, obtains the weight of the consumed fuel, then calculates the rate of fuel consumption.
5. Cooling water temperature control. During prescribed intervals in the testing, cooling water temperature must change either higher or lower.
6. Large fuel tank fuel addition control and calculation of amount used.

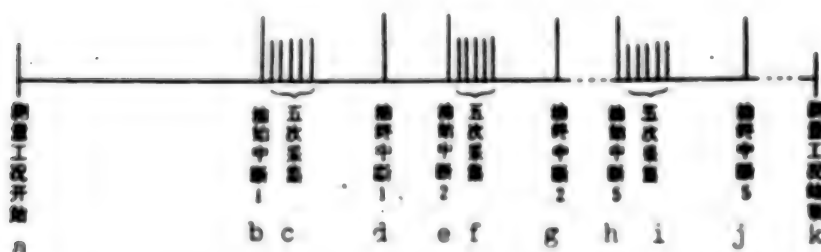


Figure 3. Data Acquisition for Fuel Consumption Measurement Operating Condition

- Key:
- | | |
|--------------------------------|--------------------------------|
| a. begin measure | g. "fuel stop" interrupt No 2 |
| b. "fuel start" interrupt No 1 | h. "fuel start" interrupt No 5 |
| c. 5 instances of acquisition | i. 5 instances of acquisition |
| d. "fuel stop" interrupt No 1 | j. "fuel stop" interrupt No 5 |
| e. "fuel start" interrupt No 2 | k. end measure |
| f. 5 instances of acquisition | |

7. The acquisition and monitoring of various data. Data acquisition occurs within a particular operating condition and may be divided into two situations. One is the situation that occurs during the operating condition regarding the measurement of fuel consumption, at which time the time for acquisition should be between the interrupts for "fuel start" and "fuel stop." At each of these instances collect 5 times, the data collected being printed out and tabulated. See figure 3. The other situation is the operating condition that is not measuring fuel consumption. At this time, the frequency for acquisition should be determined in consideration of the length of time of the operating condition, and the data collected is only displayed on the control terminal, not printed out and tabulated. If the data acquired exceeds a limit value, sound and light alarms are given through the appropriate switched output channels, and the time and substance of the limit surpassing are printed out on the line printer.

II. A Description of Data and Programs

We must now establish the necessary data and program structures to ease implementation of program design for the application system.

A. The determination of data files, data structures, and shared areas resident in internal storage.

The organization of data has a great effect on the quality of software.

To ensure the flexibility and universality of software, that data that it is possible to revise, or at time of use the organizational form of which could change, should be placed in files, edited before the test, and at the time of the test should be read into memory by the software. The primary file tables are given below.

The working condition sequence for each cycle (see figure 4(a)) should constitute one table, to be placed in a file. Each item in the table includes the two parameters of "operating condition number" and "operating condition run time." Figure 4(a) shows the table for cycle A.

The time tables for some control items provide the times that need to be controlled throughout the entire test process. For example, the control time table for the times for measuring fuel consumption are shown in figure 4(b).

Each channel table is primarily for the convenience of arranging channel sequences and providing channel attributes. Figure 4(c) provides an analog input channel table. Because having used gain program facilities, the table need not provide gain.

As the program runs, the data it should expediently access should be in a data area of the `RAM` resident in memory.

The sequence of cycles over the 120 hours should form a table. In consideration of the fact that the cycle sequences for each period in a stage are the same, this table only contains the cycles in one period. It has a

The test operating condition (and time) sequences that are the primary basis for the test process control should constitute a table. As with the situation above, it is sufficient for this table to include only the operating conditions for one period. It has a pointer pointing to the operating condition currently running. Using the test of the first stage as an example, the operating condition sequence table is as shown in figure 4(d). It is formed by the program as it begins running from selections from the set of cycle files in accordance with the cycle sequence table.

To allow the test to be used equally for various diesel engines, the rotation speed and torque values of each working condition is provided as a percentage of an index value. If the rotation speed and torque values for working condition No 35 is 100, then that is 100 percent of the index value. Rotation speed and torque for an operating condition are stored in an array by operating condition number arranged in ascending order. By taking the operating condition number as its index, the rotation speed and torque for the particular operating condition can be accessed. See figure 4(g).



Key:

a. operating condition number	h. indicator
b. time (minutes)	i. pointer
c. hours	j. rotation speed
d. minutes	k. torque
e. channel	l. seconds
f. type	m. time remaining
g. conversion coefficient	n. counter

The run time for the test and the run time left for the operating condition should be recorded in a record at the time for real-time use. A clock has been provided for this purpose. Its format is provided in figure 4(h), where the first 3 words are the time the test has run.

Using the facilities provided by the operating system, a common area has been set aside in memory for use in the rapid transfer of large amounts of data between tasks. The data used by two or more tasks, as for example the clock just described, should all be stored in this shared area.

B. A description of program structure and functions

According to a description of test requirements, we set up the main program structure as shown in figure 5. The tasks in the figure are independent program bodies running concurrently in the computer. The solid line with the arrow represents communication to "activate" or "terminate" between tasks, while the dotted line with the arrow represents sending and receiving event denotation between tasks.

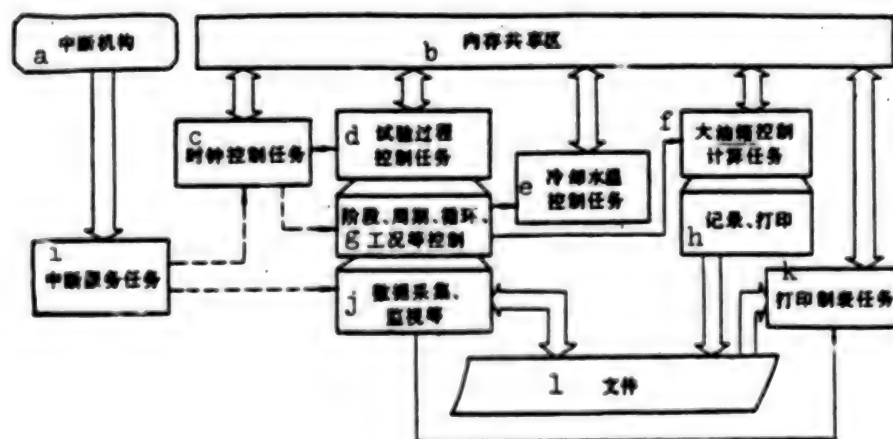


Figure 5. Software Structure [Key on following page]

Key:

- a. interrupt organization
- b. shared areas in internal storage
- c. clock control task
- d. test process control task
- e. coolant control task
- f. large fuel tank control and calculation task
- g. control of stages, periods, cycles, and operating conditions
- h. record, print
- i. interrupt service task
- j. data acquisition, monitoring
- k. print and tabulate task
- l. files

The test process control task is the main task for controlling the running of the entire test according to the test tree. It should control the conversion of the working conditions and undertake data acquisition and monitoring, etc.; it should also swap other tasks into the control process at appropriate times.

The clock control task is responsible for time control in the test process. It uses the data structures provided in figure 4(h) for this purpose: it marks the time by the event denotation issued each second by the interrupt service task, stopping after 120 hours; during each second the test is running there is one display on the control terminal screen in a fixed format, and at the same time 1 is added to the "counter," which when it reaches 60 (1 minute) a 1 is subtracted from the "operating condition time remaining." When this reaches 0, an event flag is issued to the test process control task, indicating that the current working condition has run to completion.

The interrupt service task is what initiates the two interrupt sources in the interrupt structure of the computer: interrupt type switched input and the clock board. After the interrupt switched input has been activated, the service task first identifies the switched input channel, then in accordance with the significance of the interrupt, either itself completes its service or issues corresponding event denotation to the test process control task and to other tasks. Each second, the clock board issues an interrupt, the service task generates an event flag for each interrupt, which it issues to the clock control task.

The coolant temperature control task and the large fuel tank control are ordinarily in a "sleep" state or "suspended" state with the computer tasks. At moments when they must be part of the control or of calculations, they are activated by the test process control task. When the control or calculations are finished, they return on their own to the "sleep" or "suspended" states.

The printing and tabulation task will print out data stored in the common areas or in files according to the required format. Because the speed of the printer is relatively slow, a special task is used to handle printing so as not to affect the proper operation of the main tasks.

C. Man-machine interaction and the contents of the control terminal screen display.

Before each test begins, information that must be provided by the operator is: the testing stage, normal test or non-normal (run according to temporarily constituted cycle sequences) test, the cycle sequences for non-normal test situations, test begin times, etc. It is convenient if this information is provided interactively, because when the man-machine interaction is of a prompting nature, it is clearly simpler.

During the period of the test operation, the control terminal screen displays in real-time the current stage, period (half period), cycle, operating condition, test run time, date, and standard Beijing time to aid the operator in taking charge of the test procedure.

III. Realization of the Program Design and Its Strategies

A. Top-down and successive refinement.

The topic of this subsection is the test process control task.

Regarding the overall test tree, the routines at the highest level should control a limited number of branches in the root portion. Somewhat more practical is the control of the period. We have called routines at this level "main control," the flowchart for which is given in figure 6(a). The reason that at the beginning of each new period (half period) the pointers to the cycle sequence table and operating condition sequence table are set to 1 is that each period (half period) in a stage uses only one cycle sequence table and one operating condition sequence table (see figures 4(e), 4(f), and 4(d)).

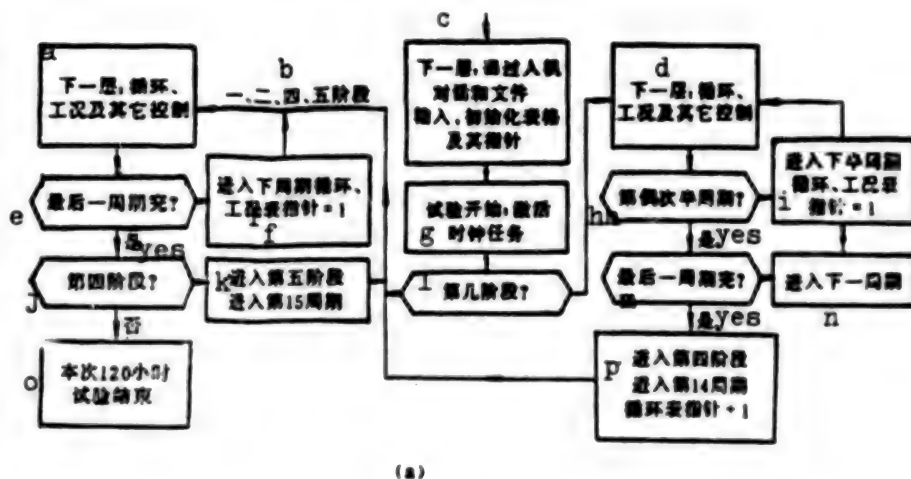


Figure 6 (a). Top-down Program Design [Key on following page]

Key:

- a. next level: cycle, operating condition, and other controls
- b. stages 1, 2, 4, and 5
- c. next level: interactively and through files initialize format and pointers
- d. next level: cycle, operating condition, other controls
- e. last period finished?
- f. input next period, cycle, operating condition tables pointers = 1
- g. test begins: activate clock task
- h. the odd half period?
- i. input next half period cycle and operating condition table; pointers = 1
- j. forth stage?
- k. input 5th stage, input 15th period
- l. which stage?
- m. last period finished?
- n. input next period
- o. 120-hour test completed
- p. input 4th stage, input 14th period, increment cycle table pointer

Before we show the next level of routines, we will only discuss the rather "deeper" "cycle, operating condition, and other controls" portion. We call this the "subcontrol level," the flowchart for which is shown in figure 6(b).

In the subcontrol level also appears three "deeper" lower levels of routines. If we reveal the "measure fuel consumption" level of routines along the main line (see figure 6(c)), the basis for this level is that the test must provide an explanation for data acquisition.

For the level just below figure 6(c)-- the primary operations in the "acquisition" level are routines to call equipment drivers, for which we offer no further description. The design of the drive routines may be included in the top-down design steps or may be independently designed. The design particulars should depend upon the computer system and the characteristics of the input/output subsystem, so we will not be more detailed here. But let us say here that in many multi-tasking computer systems there may be two types of driver routines. One is the kind of driver routine that in accordance with certain specifications writes and includes operating system uniform management; the other is the kind of driver routine where the user uses the system to access the facilities of peripheral equipment, is written using the subroutine format, and is included in the user coding space. We have called these system driver routines and user driver routines, respectively.

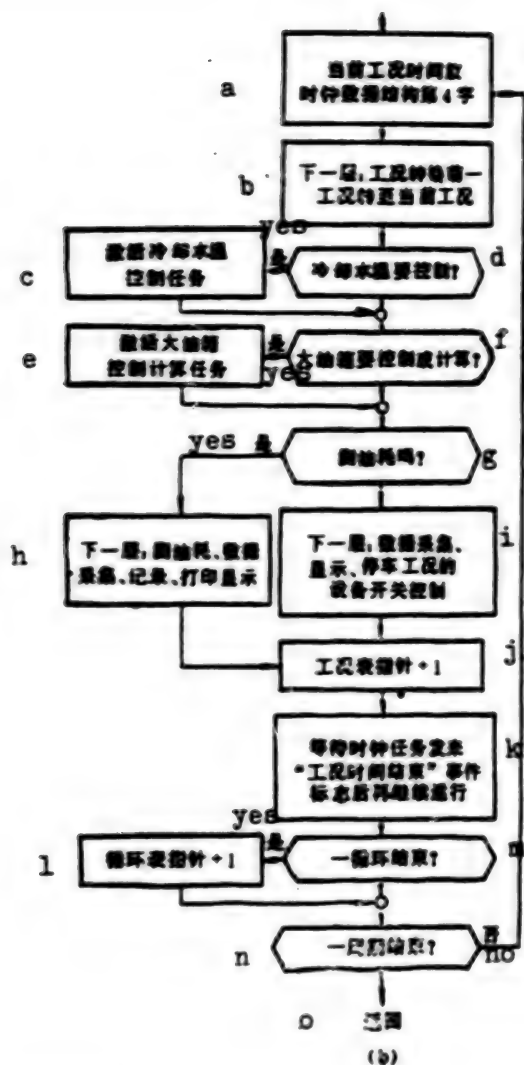


Figure 6 (b)

Key:

- a. store current operating condition time into the 4th word of the clock data structure
- b. next level: operating condition conversion, former operating condition shifts to current operating condition
- c. activate coolant temperature control task
- d. should coolant temperature be controlled?

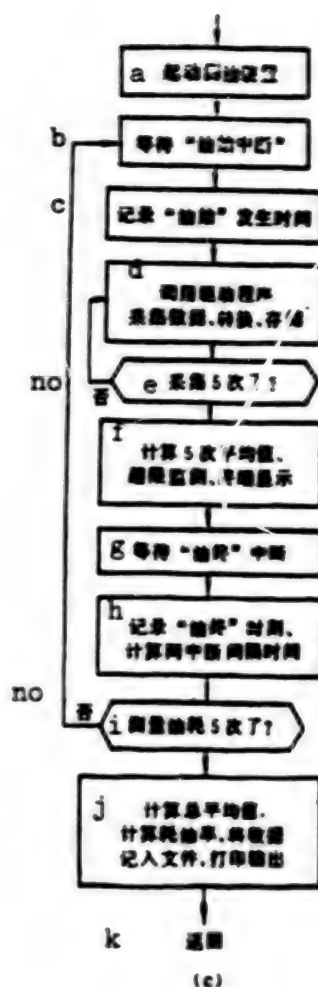


Figure 6 (c)

Key:

- a. activate fuel measurement device
- b. wait for "fuel start interrupt"
- c. record the time "fuel start" begins
- d. call driver routines, acquire data, convert, and store
- e. collected 5 instances?
- f. calculated the average value for 5 times, exceed limit monitoring measurement, terminal display

- e. activate large fuel tank control and calculation task
- f. should large fuel tank be controlled or calculated?
- g. measure fuel consumption?
- h. next level: measure fuel consumption, data acquisition, record, print, and display
- i. next level: equipment switching control for data acquisition, display, and stop engine operating condition
- j. increment operating condition table pointer
- k. wait until clock task issues "operating condition time" flag before continuing operation
- l. increment cycle table pointer
- m. one cycle concluded?
- n. one period concluded?
- o. return
- g. wait for "fuel stop" interrupt
- h. record time of "fuel stop," calculate interval between interrupts
- i. has fuel consumption been measured 5 times
- j. calculate overall average values. Calculate rate of fuel consumption, enter data into files, print output
- k. return

B. System calls and the management of shared resources

System calls are service facilities provided by the computer operating system for the user. Many requirements of tasks can be accomplished by turning them over to the operating system via system calls. For example, the system driver routines discussed above are called by the task through systems calls to accomplish input/output requirements. Communication between tasks is also done through use of system calls. Although system calls are very convenient, because they depend upon the particular computer system, portability through software is unsuccessful. We have used system calls only for activation or termination during tasks and for receiving and sending flags.

By shared resources is meant the resources of internal storage areas and peripheral equipment that tasks will use (possibly even concurrently). In using these resources we should be aware of this fact: when tasks of equal priority contend for the same resource, because they are scheduled in a round-robin way, it is quite possible that just as a particular task is reading an item of data, because it is interrupted when its time slice has been used up, another task that is ready and currently running might be changing that data

at this time. Therefore, the previous task will finally retrieve data that is contrary to the original intention.

In the situation where "user driver routines" are used, regarding access to the input/output subroutines, even more should two tasks be prohibited from accessing a subroutine at the same time. This is because in general this kind of access can only be accomplished in two or more "beats." If for example in the first beat a 16-bit channel address, state, and form information is sent, on the second beat 16-bit data is fetched (or sent). If after sending out the first beat the task is interrupted and another executing task then accesses this subroutine, the data obtained (or sent) by these two tasks could be in error, and could even bring on even more serious problems.

The most common method for solving the problem we have just discussed is to establish an event flag or "signal quantity" for each shared resource. Before the task accesses the shared resource it checks for the event flag or the signal quantity. If this is "on," it extinguishes it and accesses the resource, turning it back on after conclusion of the access; otherwise it waits until the device is "on."

C. Control and the algorithm for data acquisition

According to the description of figure 2, the entire test process constitutes a test tree. It is therefore not difficult to see that actually the control of this test process uses the algorithm of "tree traversal." In figure 6(a), for example, the decision symbol "final period completed?" is equivalent to determining whether there are any more "period" sub-nodes at the "stage" node. The decision symbol "has one cycle completed?" in figure 6(b) is equivalent to deciding whether there are any more "operating condition" sub-nodes at the "cycle" node, for if there are it would continue to investigate sub-nodes, while if none it would return to the "period" node to see whether there are any "cycle" sub-nodes, and on and on.

There are very many particulars of control involved throughout the test, so we had to use many non-numeric algorithms. This has little to do with the main topic of this paper, so we will not enumerate them.

To provide a certain flexibility for the user regarding arrangements for all input signals, (using the analog input as an example) we have used this kind of algorithm in our data acquisition routines (see figure 7):

1. In accordance with the channel number acquisition analog volume input signal provided in the first column in the channel table, converts the A/D output code into a voltage value;
2. In accordance with the nature of each channel determined by columns 2 and 3 of the channel table, converts the voltage value into a particular physical value (temperature, pressure, etc.);
3. In accordance with the fourth column in the channel table determines whether each item of data will exceed the limit.

level, gradually expanding toward the top. In this method, the lowest level routines should be set up as tasks (to aid single operation), only changing the subroutines when the debugging is over. These two methods may be used concurrently.

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DATABASE SELECTION FACTORS DISCUSSED

[Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 7, No 1, Jan 86 pp 9-12

[Article by Song Zaisheng [1345 0375 3932], Institute of Computing, Beijing University: "A Study of Database Selection Techniques"]

[Text] I. Preface

Rational selection and use of highly efficient databases is an extremely meticulous and important task. If the selection of a database is not appropriate, it is possible that only after a great deal of software work has been done will it be discovered to not meet the demands. At that time, to change the database system in use could be very difficult, leading to redesigns and to the wasting of time, manpower, and finances.

At present, the number of computers in this country has grown quite quickly, and their fields of application have extended to all sectors of the national economy. In those fields, information management is the most prevalent, while databases are the most powerful tools for information management, and are even the keys to designing applications systems. To avoid having the design of application systems get off track, we must earnestly study the problems of selecting databases. This paper explores this problem.

II. Selecting a Database

A. As much as possible, select a universal database

For each database there is an operating environment that it needs. Many databases can run in several different environments. This environment could be different operating systems, or could also be different kinds of machines. For example, dBASE II can run on various computers, such as the Apple II, Cromemco, ZD-2000, IBM PC, IBM PC/XT, etc. The Informix database can run both under the support of the XENIX operating system and also PC-DOS. By using database systems that can run like this in various environments as a basis for designed application systems, transportability can be better. Some other DBMS (database management system) software is restricted to running on only particular operating systems, or even to particular hardware environments. Using DBMS software in this kind of a single environment, although one can

resolve database management problems that are currently in urgent need of resolution, this could limit the growth of the application and would not help in transporting already developed software to other systems. Under normal conditions, we should not select that DBMS software that is too harsh in its demands on environments. This is especially true if what is to be developed is management software that is universal. If we think of the currently most urgently needed software for wage management, personnel cards management, goods and materials management, and file indexing management, if a database is selected for a single operating environment or this software is established on a database that can run on only a few machines in this country, then the significance of developing this kind of software is greatly decreased, and even less can be mentioned the economic results.

The decision regarding a database for an information management system should be made at an early stage of system design and should be considered together with the determination of hardware and operating system. Otherwise, if the hardware environment and operating system have been already determined before selecting the database, then the scope for selection of the database is greatly restricted. Of course, that method involving blind purchase and importation of machines before a search is made for a usable database is even less adoptable.

B. The requirements for database security.

What the average management system primarily manages is personnel, goods, materials, and equipment, finances, tasking, and other information. Because of differences in the data that is to be managed, differences in the nature of units, and even differences in unit levels, the differences in privacy requirements for database software can be very great. So, before selecting DBMS software, one should first of all determine what kind of privacy requirements there are for the information one is to manage. The DBMS software to be selected should have a level of security measures. Some DBMS software have a particular privacy function (some have control over read/write authority at the field level and some have privacy functions at the file level). Some databases have no privacy measures at all. For example, the currently popular dBASE II, because it is easy to use and may be run on various machines, has the reputation of being a popular relational database, but no database privacy measures at all are provided. This has become a real headache, and it can only be used in situations where privacy requirements are not high, or additional artificial means must be adopted. Recently, someone in this country developed a version of dBASE II that has measures for database privacy, and we hope that this can supplement this deficiency. Aside from this, I feel that if a database does not itself have the need for a certain level of privacy, there is no need to artificially raise the security requirement for a database. Instead, selection may be limited to a very commonly used database, such as dBASE II.

C. Recoverability of a database

When we use a database, we always hope that the contents of the database are reliable and accurate, and naturally do not wish the database to be destroyed. In database systems, this problem has been called the problem of database

integrity. However, when systems encounter failures, databases can certainly be destroyed, so there should be an effective method to recover lost data.

Although the data stored in a database is kept on equipment such as disks and tape, where the effects of power source equipment and other faults are rare, disk storage itself can have problems, and during so-called "head crashes" can even lead to the complete disappearance of data. Magnetic storage devices can also lose data through the effects of external strong magnetic fields. Obviously, in database systems we must provide effective measures to ensure the integrity of data.

First of all, DBMS systems should provide a function to generate back-up copies. As soon as the system experiences a major fault, and especially when data on a disk has been destroyed, one can recover the entire database from this.

In real database applications it is never the case that there is only non-changing data that is only looked at and used for generating statistical reports. Rather, this data is under constant revision. The contents of volatile memory that has been revised but not yet stored on the page of a magnetic disk is greatly affected by system faults. In this case, reliance on periodic back-up copies cannot resolve this problem. A more effective method must be used. As we undertake information exchanges in a database, we can at the same time establish an audit trail file, which can record the entire process of information transactions between the database and things outside it. If a system should encounter faults, through this audit trail file it can recover data from the time the audit trail file was begun (generally, the time of the last back-up of the database) to the time of the system fault. Generally, this kind of file is not on the same hardware equipment as the data itself. If the database is on a hard disk, this audit trail file could be on tape, floppy disk, or another hard disk.

If use of the audit trail file makes it so that on each occurrence of information transactions the "history" of the data transactions will be recorded on slow-speed equipment, this will obviously lower the operational efficiency of the entire system. Kind of data integrity is required is a question well worth consideration.

D. Reaction time

The majority of DBMS systems provide easy to use search, statistical, and report generation functions, either through a non-procedural language or through a series of commands. For the Informix database running under the UNIX operating system, for example, an inquiry language called "Informer Query Language" and a report generation language called "ACE" are provided. In dBASE II and III are provided inquiry commands and commands for generating report formats. The user normally works with the database on this level to inquire of or edit the data on the disk. In comparison with low-level software that directly reads and writes to the disk, this level of contact is much simpler to use, but this is done in the place of time. Because a great amount of information in a database is stored on disk and not in memory, it must be called in from internal storage through certain algorithms, only after

which can it be displayed on the CRT or output to the printer. The inquiry response time depends not only upon the operational speed of the hardware system, but also upon the algorithm used to call out information from the disk. Still using dBASE II as an example, because it was originally a database that ran on 8-bit machines with 64K RAM, its operating efficiency is not great. When ported to the 16-bit machines (as for example the IBM PC/XT), this problem still remains. I once did an experiment on a database of 5,875 records where each record had 157 bytes, and where by using the "locate" command to go to the last record it took 135 seconds. While on the one hand the dBASE III designed directly for the 16-bit machines maintains compatibility with dBASE II, on the other hand its performance and operating efficiency have been improved. The Informix database that runs under UNIX has been ported to 16-bit microcomputers from the higher level computers, and its calling out algorithm is more suited to the larger memory capacities of the 16-bit machines. Compared with dBASE II, it also operates more efficiently.

In summary, because the design backgrounds for databases are different, the algorithms for calling out disks can differ greatly, and inquiry response time is a problem worth considering. This is especially true when there are a great number of records. We should first of all establish a small database for this problem of response time to measure and calculate response time, after which figuring the response times when there are very large numbers of data records. Check whether this fits the requirements. If there is no measurement and calculation of response time, in tests of the database when data is not large the system might work well, but when the data is suddenly larger the inquiry time could be too long and even intolerably so. This could lead to problems that are not easily supplemented.

E. Capabilities for Chinese character support and the backgrounds of firms

As we disseminate computer applications in this country, we must solve the problem of Chinese character information handling. It is the same with the use of a database. Aside from areas where the level of particular specialties is quite high, direct use of database systems in the ASCII code that foreign computers can only store has generally not been accepted. The ways in which databases support Chinese characters depends upon the ways operating systems support Chinese characters. There are already many ways at present to do this, and there are even several operating systems for the same machine that support Chinese characters. The following methods are the most common:

1. International coding is used in the operating system with the highest bit set to "1" to indicate Chinese characters.
2. Three-digit ASCII code (alphabetic, numeric, alphabetic or numeric) represents each Chinese character.
3. The method where there is an indicator at the beginning and end of Chinese character information.

Systems and databases that depend upon the three methods just described to support Chinese characters each has its good and bad points and are suitable for different situations. The method where the operating system internally

recognizes a set high bit is flexible and saves storage space. But using this method requires revision of the original operating system on the computer and even of the DBMS software itself. Since this requires sufficient reference materials on the machine internals, this is most suitable for microcomputers. For mini- and mainframe computers there are nearly no materials on the operating systems themselves, so the method to recognize a set high bit to support Chinese Characters is rather difficult. There, it is more suitable to use "external resolution" methods. We can use 3-digit ASCII code to represent a Chinese character, and can even use the method of indicating the beginning and end of Chinese character segments. In this way we need not revise the machine's original operating system, and recognition of Chinese character and ASCII code can be done on the terminal or by connecting a converter between the main system and the terminal. Because the "3-digit" scheme requires 3-digit ASCII code to represent one Chinese character, this will require approximately one-third more storage space than the method of indicating the beginning and end of Chinese character segments. Three hundred megabyte disks can store 150 million Chinese characters, but storage capacities that can now only store 100 million or 50 million Chinese characters lose out, which is intolerable in some situations. Chinese character support of different kinds should be selected in accordance with particular conditions.

There are currently many database systems, and there are also a fair number that support Chinese characters. When selecting a database, aside from considering technical factors related to database performance, one should also consider the support background of the developing company and firms associated with the database. This is also a question considered in selection of a database abroad. As much as possible, companies in the first line of development capability or products from research units should be selected, and special consideration should be paid to firms in regard to conditions in the following areas:

1. Have they the capability for promptly handling problems that appear in database software.
2. Do they have complete user manuals, and do they have the capability of providing training.
3. Have they the capacity to continue developing other software.
4. Do they provide accompanying Chinese character software.

These points are all quite important. Looking only at the fourth point, a Chinese character database system requires various accompanying support software: for handling rare characters encountered in ancient books or in people's names, firms should provide character form generation programs; to improve input speed, firms should provide phrase generation programs; should even provide windowing software and graphics software to be used together with the database. If firms cannot provide this kind of software or cannot continue to develop this kind of software, it would be hard for this database to accomplish highly effective management efforts.

F. The user interface

In transaction management systems, the end-user could be any kind of office worker or operator. From the point of view of the current situation in this country, these people are invariably unfamiliar with computers, and to allow them to directly use the QUERY inquiry language or report generation languages or commands to open some audit trail file would not be practical. It is always necessary for the computer workers to develop a software package for them that will constitute a more "friendly" user interface. This software package should completely use Chinese characters as prompts for system functions and operation steps, and should work with menus or other simply understood formats. Therefore, when selecting a database, one should also appropriately consider the degree of difficulty for creating this software package.

III. Conclusion

In this paper we have only discussed some of the problems involved with the techniques for database selection. Others, such as what kind of high level languages may access the database, what kind of data dictionary is required, and what kind of flexibility is required should all be given particular study in light of application projects of differing demands.

12586

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SINGLE-AXIAL-MODE Nd:YLF OSCILLATOR FOR LASER FUSION SYSTEM INVESTIGATED

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6, No 9, Sep 86
pp 769-775

[Article by Cao Weilou [2580 3262 2869], Chen Qinghao [7115 1987 3185], Zhu Zhimin [2612 2535 2404], Chen Shaohe [7115 4801 0735], and Deng Ximing [6772 6932 6900] of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, and Sun Yunlong [1327 0061 7893] and Jie Qiao [6043 2890] of the North China Research Institute of Electro-Optics, Beijing]

[Text] Abstract: Single-axial-mode Q-switched Nd:YAG and Nd:YLF oscillators with quasi-CW prelude or pulsed prelude have been developed successfully. This paper is the first report on the long duration 100 percent single-axial-mode operation of a pulsed prelude Q-switched oscillator by cavity length control. The Nd:YLF oscillator has been used in a large laser fusion system.

I. Introduction

The laser oscillator is one of the central components in a large scale laser fusion system. When the power density of the laser reaches several thousand megawatts, the spatial and temporal modulation causes severe self-focusing and autophase modulation. As a result, the laser energy may damage the optical components, the lasing material and the various optical thin films and renders the entire system inoperational. Furthermore, severely modulated laser pulses complicate the laser-plasma interaction and are empirically untractable. In order to reduce the nonlinear effects of the high power laser, the output energy and the pulse width of the laser oscillator must be stable and their temporal and spatial distribution must be smooth. Single-axial-mode oscillators can meet these requirements satisfactorily.

Single-axial-mode laser oscillators have been reported in a number of literature articles,²⁻⁵ but the reported studies all suffer from a common problem, namely, the single-axial-mode operation cannot be maintained over a long period of time and severe modulation of two or more axial modes may exist simultaneously. In order to obtain single-axial-mode operation, an optical etalon is often placed in the resonance cavity to reduce the bandwidth. If the time for establishing Q-switching can be lengthened, then the etalon may more effectively suppress the unwanted axial modes. Generally speaking, a well-designed single-axial-mode laser can still only operate for several

minutes and reduce the probability of modulation to 1 percent or one-tenth of 1 percent; but this is far from being adequate in laser fusion. Because the optical components and films of a high power laser system often work near their limits, one occurrence of a modulated output may be enough to damage many optical components and cause enormous loss.

The new design resulting from our work ensures that the laser output for each firing is a smooth single-axial-mode. We have conducted tests using a 1.064 μm Nd:YAG laser and a 1.053 μm Nd:YLF laser.

II. Physical Design of a Single-Axial-Mode Oscillator

The single-axial-mode operation of a solid state laser is generally much more difficult than that of a gas laser. This is because the linewidth of a solid laser is much greater than that of a gas laser. For example, the linewidth of the 1.054 μm radiation of a phosphate Nd glass laser is 210 cm^{-1} , the gain linewidth of a 1.053 μm Nd:YLF laser is 12.5 cm^{-1} , and the gain linewidth of a 1.064 μm Nd:YAG laser is 6 cm^{-1} . All of these are greater than the linewidth of a He-Ne laser by more than two orders of magnitude.

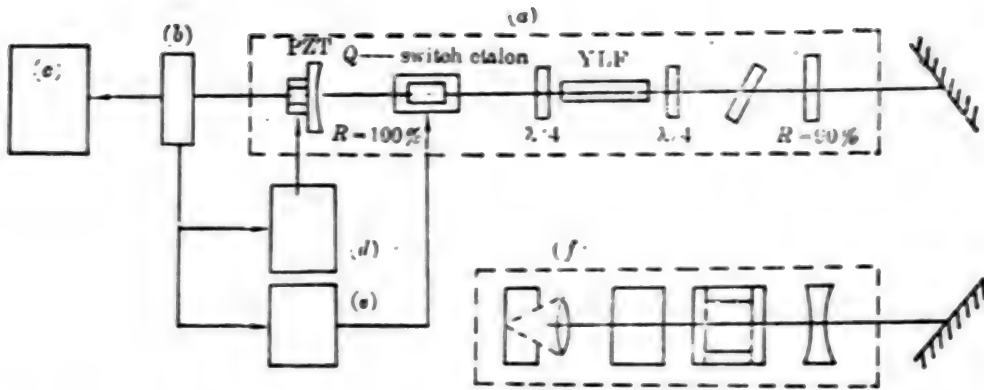
Moreover, the spatial hole-burning effect of the standing waves in a solid state laser cavity can easily excite adjacent axial modes and lead to severe modulation (beating); whereas in a gas laser such effect may disappear with the diffusion of the gas. Also, in terms of frequency stabilization, a solid laser does not have the benefit of the Lamb dip as a frequency stabilization reference point that exists in the gain curve of a gas laser. Because of the high gain and the long lifetime of the excited state of a solid laser, frequency stabilization by cavity length control often lead to relaxation oscillation. The high level of power, however, requires the use of a solid medium for the oscillation and amplification. Also, since the gain in a solid is basically in the uniform broadening regime, once a certain axial mode dominates the oscillation, the entire gain curve is suppressed, which is very favorable for suppressing other axial modes.

Based on the analysis above, we designed a single-axial-mode laser system shown in Figure 1. We eliminated the standing waves by placing two orthogonal $\lambda/4$ plates at the two ends of the medium and effectively suppressed the oscillation of adjacent axial modes. To suppress the linewidth, we placed a 2 cm thick etalon in the cavity. The end face reflectivity R of the etalon is 65 percent and the sharpness coefficient F is given by

$$F = \frac{4R}{(1-R)^2} = 21.$$

The free spectral width is

$$\Delta\nu_{\text{FSR}} = \frac{c}{2nd} = 50 \text{ GHz, or } 1.67 \text{ cm}^{-1}.$$



(a) oscillator; (b) detector; (c) oscilloscope; (d) PZT power supply; (e) Q-switched power supply; (f) frequency monitor

Figure 1. Layout for experiment

The reflection fringe fineness, defined as the free spectral width divided by the resolution bandwidth, is

$$\mathcal{F} = \frac{\nu_{N+1} - \nu_N}{|\nu - \nu'|} = \frac{\pi}{2} \sqrt{F} = \pi \left(\frac{\sqrt{R}}{1-R} \right) = 7.2.$$

The resolution bandwidth is

$$\begin{aligned} \Delta\nu_{\text{res}} &= |\nu - \nu'| = \frac{c}{\pi nd} F^{-1/2} = \frac{c}{2\pi nd} \left(\frac{1-R}{\sqrt{R}} \right) \\ &= \Delta\nu_{\text{auto}} / \mathcal{F} = 7 \text{ GHz}, \text{ or } 0.23 \text{ cm}^{-1}. \end{aligned}$$

The resolving power is

$$RP = \frac{\nu}{\Delta\nu_{\text{res}}} = \mathcal{F} \frac{2nd}{\lambda} = N \cdot \mathcal{F} = N\pi \left(\frac{\sqrt{R}}{1-R} \right) = 4.8 \times 10^4,$$

where N is the order of interference.

Our primary concern is the frequency selection ability of the etalon. In the resonance process, the laser passes through the etalon repeatedly. For pulsed prelasing, the prelasing time is $1 \mu\text{s}$ and the optical path length of the cavity is 25 cm (0.8 ns). N is of the order of 10^3 . For a quasi-CW prelasing, the time is 2 ms and N may be as high as 1.4×10^6 . For a light passing through the etalon repeatedly, the frequency selection ability of the etalon may be described by the equivalent fringe fineness \mathcal{F}_x . It may be shown⁶ that, for $N \gg 1$, $\mathcal{F}_x = 1.2\sqrt{N}\mathcal{F}$. Therefore, $\mathcal{F}_x = 272$ for a pulsed prelude and $\mathcal{F}_x = 10^4$ for a quasi-CW prelude. The equivalent resolution bandwidth of the etalon is therefore $\Delta\nu = \Delta\nu_{\text{auto}} / \mathcal{F}_x = 0.184 \text{ GHz}$, or 0.006 cm^{-1} for pulsed prelude and 5 MHz or $1.7 \times 10^{-4} \text{ cm}^{-1}$ for quasi-CW prelude.

Using this design, we use the first pulse of the relaxation oscillation as the prelude pulse and perform Q-switching at its top or tail. For quasi-CW prelude, the time for Q-switching is chosen at the end of the relaxation oscillations and after the prelude output has stabilized (see Figure 2). To obtain a stable single-axial-mode output, we naturally must make the axial mode frequency coincide with the peak transmission frequency of the etalon and the peak frequency of the gain curve. This calls for precise control of the tilt angle of the etalon and the cavity length. Usually we first adjust the tilt of the etalon to make the last two frequencies coincide and then fine tune the cavity length with a piezoelectric ceramic so that all three frequencies coincide.

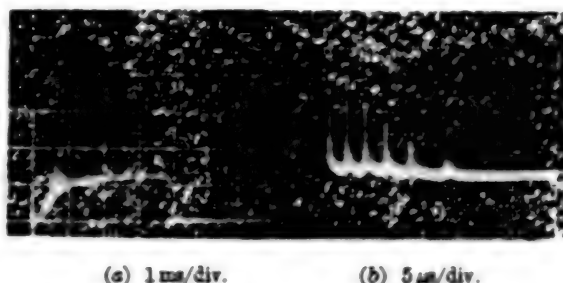


Figure 2. Oscillograms of the quasi-CW prelude and pulsed prelude

Because the separation of the axial modes of the resonance cavity is

$$\Delta\left(\frac{1}{\lambda}\right) = \frac{1}{2nd} = 0.02 \text{ cm}^{-1}, \text{ or } 0.6 \text{ GHz}.$$

the spectral width of the free oscillation without the etalon is about 1 cm^{-1} . The free spectral width of 1.67 cm^{-1} and the resolution bandwidth of 0.006 cm^{-1} of our etalon can not only suppress the remote modes but also the adjacent modes.

III. Experimental Study of the Single-Axial-Mode Laser

In order to improve the selectivity of the single axial mode, we choose 3 ms as the quasi-CW prelude time. Within this time period all the axial modes compete with each other and a few axial modes with the least attenuation finally become dominant. In the pulsed mode the base width of the first relaxation pulse is 1-2 μs and the axial modes also compete with each other in their almost one thousand passages in the cavity. This effect may be easily observed in the experiment. The laser light obtained by pure Q-switching is distinctly different from the laser light obtained under prelude Q-switching. The former has severe modulation and its spectrum shows sidebands. The latter is smooth both temporally and spectrally. Figure 3 shows the results taken by a streak camera.

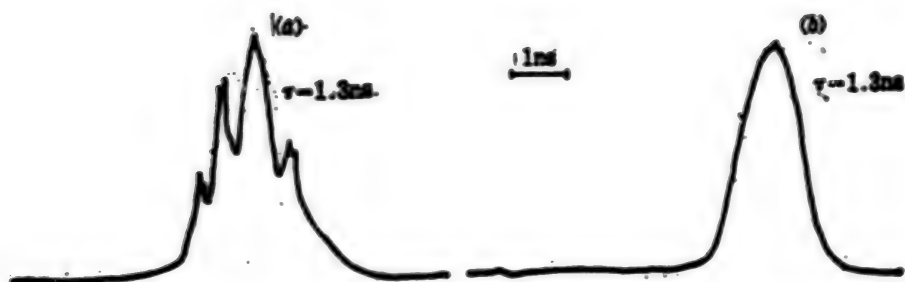


Figure 3. Temporal profiles of an ordinary Q-switched laser pulse (a) and the single-axial-mode laser pulse (b) taken by a streak camera

We observed the laser output using a Hamamatsu model R1193 μ -01 high current photoelectric tube and a fast oscilloscope. In adjusting the etalon, one should be careful that no subcavity is formed with the cavity plate. The tilt angle is adjusted for the minimum threshold. The cavity length is adjusted by the piezoelectric ceramic on the rear cavity plate. We have obtained stable single axial mode operation and double mode operation (see Figure 4).

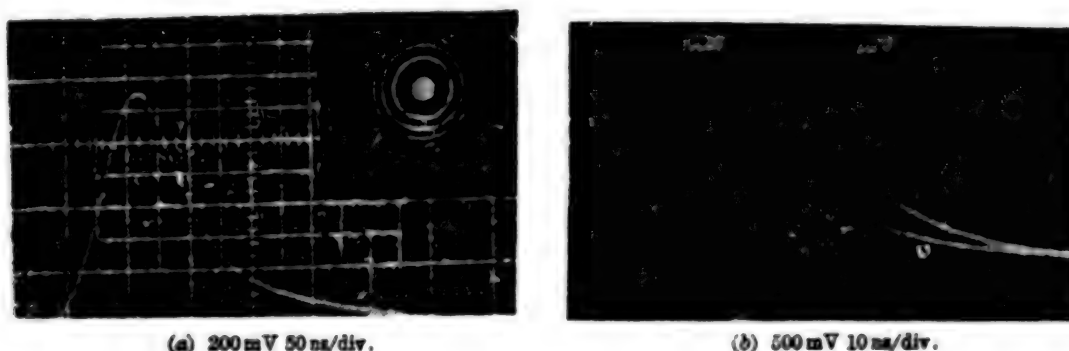


Figure 4. Spectral and temporal characteristics of the laser pulses of single axial mode (a) and double axial modes (b)

Mechanical instability, thermal effects and other environmental factors may cause the axial mode to drift. In order to have long periods of single axial mode operation, the cavity length must be controlled by a feedback signal chosen from the laser output characteristics. This is a key problem to be solved in our laser system.

IV. Stability of Quasi-CW Prelase Q-Switched Single Axial Mode Laser

After careful observations of a Nd:YAG quasi-CW prelase, we discovered that, when the single axial mode output is stable, the prelase signal was very smooth and the prelase amplitude was constant. When the cavity length was changed by a small amount, the slope of the prelase amplitude also changed (see Figure 5). The slope change was not observed in Nd:YLF. This is because the Nd:YAG crystal is heated by the pumping and expands, causing the length of the cavity to change and the wavelength to drift during the

entire prelude period. Since the cavity length change is slow, the wavelength is swept slowly and does not cause any sudden changes of the laser output. For a Nd:YAG laser it is always the positive thermal self-focusing that is observed experimentally. In the prelude the effective length of the Nd:YAG crystal always increases; that is, the wavelength of the laser increases gradually during prelude. For a Nd:YLF crystal, the coefficient of thermal expansion is very small and the phenomenon in Nd:YAG is not observable.



Figure 5. Slope characteristics of the quasi-CW prelude

Figure 5 shows the different positions of the axial modes in a Nd:YAG cavity with respect to the transmission peak of the etalon. In Figure 5(a) an axial mode is very close to the etalon peak at the onset of prelude. During prelude this axial mode slowly sweeps across the etalon peak. Since the change in etalon transmissivity is very small at this time, the change in prelude is also small. Since the axial modes on the two sides suffer more attenuation, they are suppressed below threshold and cannot oscillate. If the initial position of the axial mode is to the left or to the right of the etalon transmission curve, the prelude gain will gradually increase or decrease. Adjacent modes are still below the threshold, as shown in Figure 5(b) and (c). We now examine a different situation where axial mode 2 oscillates and axial mode 1 is below the threshold in the initial phase of the prelude. As frequency drifts the gain of mode 1 becomes greater than the gain of mode 2. Mode 1 then begins to oscillate and mode 2 becomes suppressed. The laser output will alternate between the two modes and the laser frequency undergoes transitions. The prelude will again show relaxation oscillation, an undesirable experimental situation.

The above experiment shows that the slope change of the prelude output of a Nd:YAG laser is an important indicator of the relative position of the axial mode and the etalon peak. By comparing the initial and final prelude signals and using the difference signal as feedback to correct the cavity length, the laser will be stabilized in the state shown in Figure 5(a) and long term stable operation of the single axial mode can be achieved. For a quasi-CW Nd:YLF oscillator, one must determine the relative position of the axial mode and the etalon peak by active sweeping. This requires the application of a sawtooth voltage on the piezoelectric ceramic in the prelude period to achieve the same results in Nd:YAG.

V. Probability of Single Axial Mode in a Pulsed Prelase Q-Switched Oscillator

A pulsed prelude is of course much simpler than a quasi-CW prelude. However, the probability for achieving a single axial mode operation in all the pulsed Q-switched laser systems studied to date has been far less than that of a quasi-CW prelude system.^{6,7} This is because of the short time duration of the pulsed prelude. Neither thermal effects nor artificial change of the cavity length permit the determination of the relative position of the axial mode and the etalon peak. Without this reference signal, the cavity cannot be maintained at its optimal length. American scientists have investigated this problem for many years without finding a solution.⁶

To solve this problem we first analyze the competition between two adjacent axial modes.

Let the intensity gain of the principal axial mode for one roundtrip in the cavity during prelude be $g_1(t)$, then we have

$$g_1(t) = \exp[2\sigma_1 \Delta N(t) l] R_1 R_2 T_1^2 T_0^2, \quad (1)$$

where $\Delta N(t)$ is the population inversion density, l is the length of the gain medium, T_0 is the transmissivity before Q-switching and T_1 is the etalon transmission. After the threshold is reached, the change of the principal axial mode intensity dP within a time interval dt increases according to the following equation:

$$dP_1(t) = P_1(t) [g_1(t) - 1] dt / 2\tau, \quad (2)$$

where 2τ is the roundtrip time in the cavity.

For simplicity we assume that the population increases linearly with time and ignore the saturation effects of the gain. Then

$$\Delta N(t) = at - \beta, \quad (3)$$

Substituting (3) into (2) and performing the integration, we have

$$P_1(t) = P_1(t_1) \exp[\sigma_1 2l (t - t_1)^2 / 2\tau], \quad (4)$$

Here we used $g_1(t_1) = 1$.

Since the adjacent mode 2 grows in a similar manner, the intensity ratio of the two modes is

$$P_1/P_2 = \exp[\sigma_1 2l (t_1 - t_2) (t - t_1) / \tau], \quad (5)$$

Here we made the approximations $\sigma_1 = \sigma_2 = \sigma$, $t_1 \approx t_2$. From the threshold condition, we have

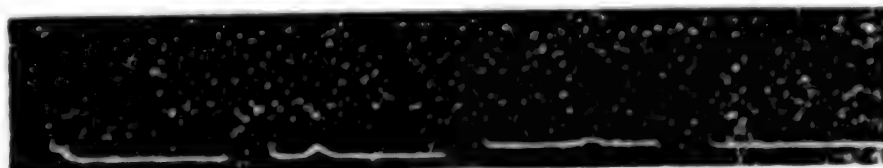
$$P_1/P_2 = (T_1/T_2)^2, \quad (6)$$

For a cavity length much greater than the etalon thickness, we obtain

$$P_1/P_2 = \left[1 + \frac{1}{L \Delta\nu_{\text{tran}}} \right]^N, \quad (7)$$

where L is the optical length of the cavity, $\Delta\nu_{\text{tran}}$ is the resolution bandwidth of the etalon for a single passage and N is the number of oscillations. For a better single axial mode selectivity, the number of oscillations should be large, the cavity length should be short and the etalon should have a narrow transmission bandwidth. In our experiment $L = 25$ cm, $\Delta\nu_s = 0.23$ cm⁻¹, $N = 10^3$, we therefore have $P_1/P_2 = 31$. The discussion above pertains to the situation where the two adjacent modes are located on the same side of the etalon transmission curve. If the adjacent modes are symmetrically located on the two sides of the transmission curve, their transmissivity, and hence their intensity ratio, may be very close to being equal. In this case the two modes will oscillate simultaneously and the above mode selection scheme will not work.

We made a significant advance in determining the relative position of the axial mode and the etalon transmission curve by using the temporal characteristics of the oscillation of two adjacent modes. We further used this as a reference signal in controlling the cavity length so that the principal axial mode is always located at the peak of the etalon transmission. We used the first pulse as the prelude and carried out Q-switching at its top or tail. The principal axial mode then provided a giant pulse output. Upon opening of the Q-switching, the adjacent mode was also set into oscillation but at a delayed time. The laser output is shown in Figure 6. The time interval between the onsets of two adjacent axial mode oscillations and the amplitude of the adjacent mode are determined entirely by the relative position of the axial mode and the transmission peak. By adjusting the voltage on the piezoelectric to vary the cavity length (and shift the axial mode position), the time delay and intensity of the adjacent mode can then be controlled. The greater the time delay, the weaker the adjacent mode. This experimental result is in fact predicted by Eq. (5). Using this characteristic, we achieved semiautomatic and automatic control of the cavity length and ensured 100 percent single axial mode operation over extended length of time. Since the Q-switching signal is taken from the prelude, the amplitude and width of the Q-switched laser pulse are also very stable; both within ± 5 percent. By changing the input power to the modulator, the width of the Q-switched laser pulse can be continuously varied between 30 ns and 100 ns.



(a) $V_{PST} = 30$ V

(b) $V_{PST} = 40$ V

(c) $V_{PST} = 60$ V

(d) $V_{PST} = 80$ V

(0.5 μ s/div.)

The pulsed prelude Q-switched single axial mode Nd:YLF laser has now been used as an oscillator of the phosphate glass laser system in large scale nuclear fusion. The single axial mode Q-switched laser pulse may be shaped and amplified to obtain smooth nanosecond, kilojoule giant pulses of various width, as shown in Figure 7.

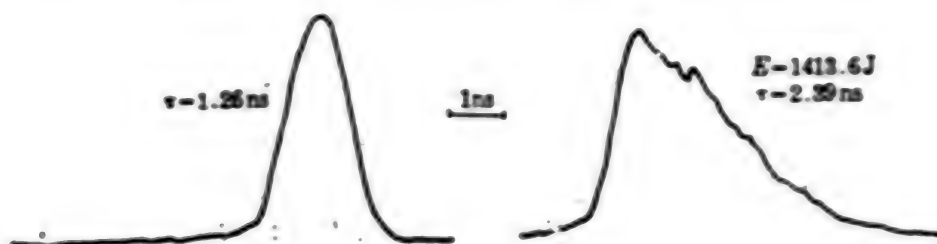


Figure 7. Sliced single-axial-mode laser pulses taken by a streak camera

The mechanical design of the oscillator was done by Qiao Putang [0829 4395 1016], the modulator was provided by Li Shiyang [2621 1102 5391], and Xu Renfang [1776 0088 5364] participated in the research. The authors acknowledge their contribution.

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9698/6091

CSO: 4008/11

IRON-RING WIGGLER USED IN FREE-ELECTRON LASER

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6, No 9, Sep 86
pp 776-780

[Article by Chu Cheng [5969 2052], Hu Yu [5170 3558], Lu Zaitong [7120 6528 6639], Shi Ruigen [2457 3843 2704], and Zhang Lifan [1728 4539 5358] of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] Abstract: We have made numerical calculations for the iron-ring wiggler used in one free-electron laser based on stimulated Raman scattering. The theoretical results were borne out by experimental measurements. By using this wiggler together with a guiding magnetic field as the pumping source, we have obtained free-electron laser radiation.

I. Introduction

In the Raman free electron laser that we developed,¹ the high current electron beam is guided and confined by an axial magnetic field. The alternating iron ring-copper ring wiggler² is based on the Raman free electron laser. Because the presence of a high μ ferromagnetic material distorts the otherwise homogeneous distribution of the guiding magnetic field, a transverse magnetic field component is introduced at the location of the electron beam. This periodic transverse magnetic field provides the wiggler field that pumps the electron beam. We have conducted numerical analysis and experimental tests for the iron ring wiggler. The results showed that, at the location of the electron beam (3-7 mm from the axial line), the peak value of the transverse magnetic field was 8-28 percent of the guiding magnetic field and satisfied the overall operational requirements of the device. Using this iron ring wiggler and a guiding magnetic field to pump the electron beam, we obtained free electron laser radiation.

II. Theoretical Calculation

In terms of magnetism only, the presence of the copper ring may be neglected. Figure 1 shows a cross-section of the iron ring wiggler and the region for the theoretical calculation selected on the basis of symmetry considerations.

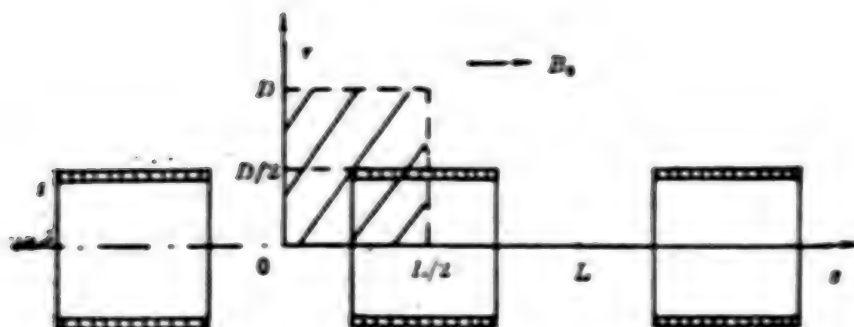


Figure 1. Cross-section view of the iron-ring wiggler. The shadowed block area is the region where computer calculation is made.

To simplify the problem, we consider the static field distribution in an infinitely long iron ring wiggler. The thickness of the iron ring is assumed to be much less than the dimension used in the calculation, μ is assumed to be infinity and the magnetic field at large r is assumed to be the guiding field B_0 . Under these conditions the magnetic field is $B = -\nabla\phi$, and the potential ϕ satisfies the Laplace equation:

$$\nabla^2\phi - \frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial\phi}{\partial r} \right) + \frac{\partial^2\phi}{\partial z^2} = 0, \quad (1)$$

The boundary conditions are

$$\begin{cases} \frac{\partial\phi}{\partial r} \Big|_{r=0} = \frac{\partial\phi}{\partial r} \Big|_{r=L} = 0, \\ \frac{\partial\phi}{\partial r} \Big|_{r=L} = 0, \quad \frac{\partial\phi}{\partial z} \Big|_{r=L} = B_0, \\ \nabla\phi(r, z) = \nabla\phi(r, z+L), \\ \phi|_{r=0} = \text{finite} \end{cases} \quad (2)$$

After mathematical derivation, we found that the magnetic field in the region $r = L/2$ is given by

$$\begin{cases} B_r = \sum_n A_n \omega_n \sin \omega_n z J_1(\omega_n r), \\ B_z = \sum_n A_n \omega_n \cos \omega_n z J_0(\omega_n r), \end{cases} \quad (3)$$

where $\omega_n = \frac{2n\pi}{L}$, A_n is a coefficient to be determined, and J_1 and J_0 are Bessel functions.

Although the boundary condition at $r = L/2$ cannot be easily determined and Eq. (3) cannot provide quantitative data, but Eq. (3) shows that: $B_r = 0$ when $r = 0$, B_r and B_z are functions of z , and B_r is a maximum at $z = L/4$. These predictions agree with the numerical calculation and experimental results discussed below.

To obtain quantitative results, Eq. (1) is solved with the finite difference method. Figure 2 shows a typical calculation result. It clearly shows the periodic changes of the magnetic field and the resultant transverse (in the direction of r) magnetic field component. For the dimensions used in the experiment ($D = L = 22$ mm), the z dependence of the axial magnetic field B_z and transverse magnetic field B_r at different radial locations are computed. The results are shown in Figure 3. As can be seen, the B_z fluctuation on the axis is $\Delta B_z/B_0 = 14$ percent, and $\Delta B_r/B_0$ is equal to 8 percent at $r = 3$ mm and 28 percent at $r = 7$ mm. The value of B_r increases with increasing r .

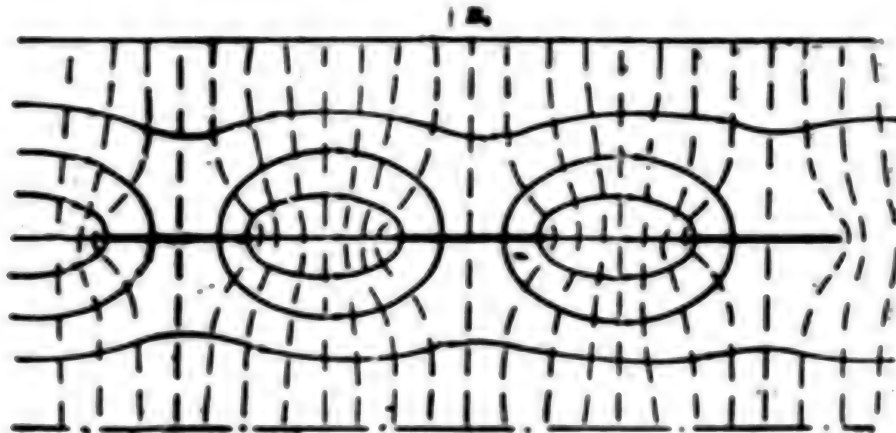


Figure 2. Computer calculated results of the magnetic field of an iron-ring wiggler with $L = D$. Solid line--magnetic field B ; Dashed line--magnetic potential ϕ

Since the implementation calls for iron ring wigglers with different L/D , computations were made for a series of L/D values and the results are shown in Figure 4. Figure 4 clearly shows that the fluctuations in the axial and transverse fields decrease rapidly as L/D decreases. This is detrimental to the operation of the device. In other words, one cannot hope to further decrease the wavelength of the free electron laser by using a small period iron ring wiggler. This is an important conclusion.

III. Experimental Tests

The differential signal dB/dt on the axis of the wiggler is probed with a small test coil. The 325 turn test coil has a diameter of 2 mm and is wound with 0.1 mm diameter varnished copper wire. The differential signal is then integrated with a home built Miller integrator and displayed on the oscilloscope. A typical waveform is shown in Figure 5. The measured on-axis axial magnetic field is shown in Figure 6, together with the computed theoretical value. The good agreement proves the correctness of the numerical calculation.

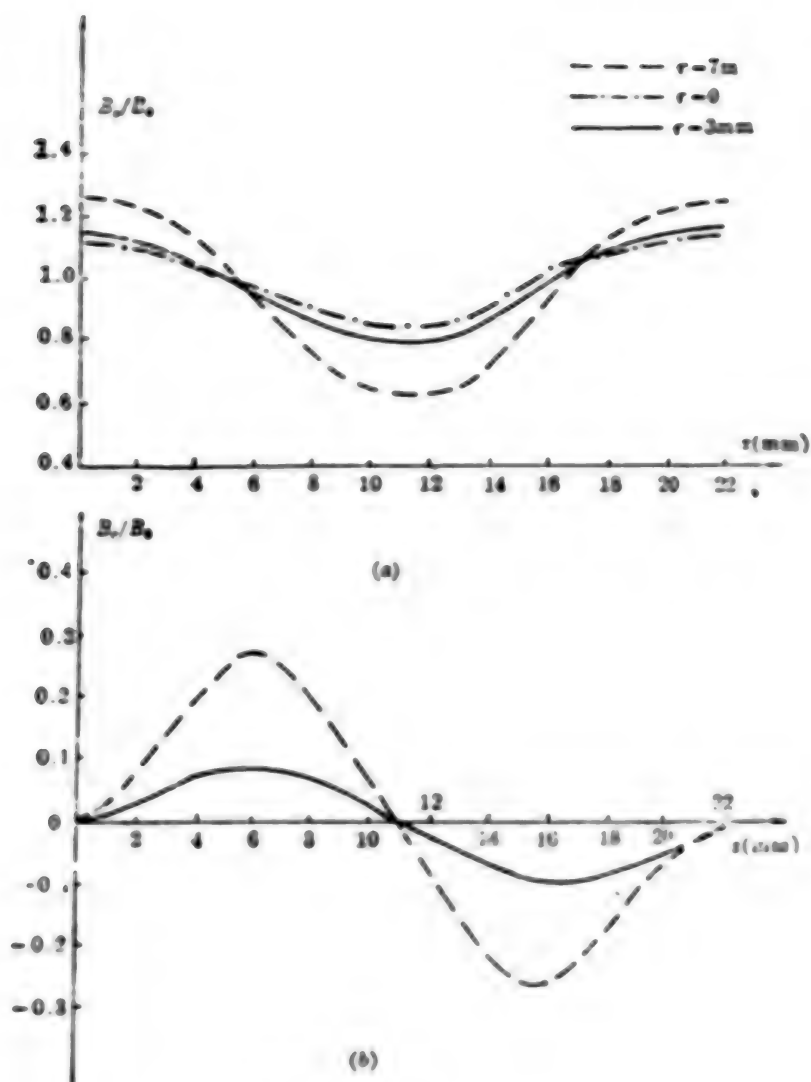


Figure 3

(a) Axial component B_z vs. axial distance z ; (b) Radial component B_r vs. axial distance z for $D = L = 22$ mm

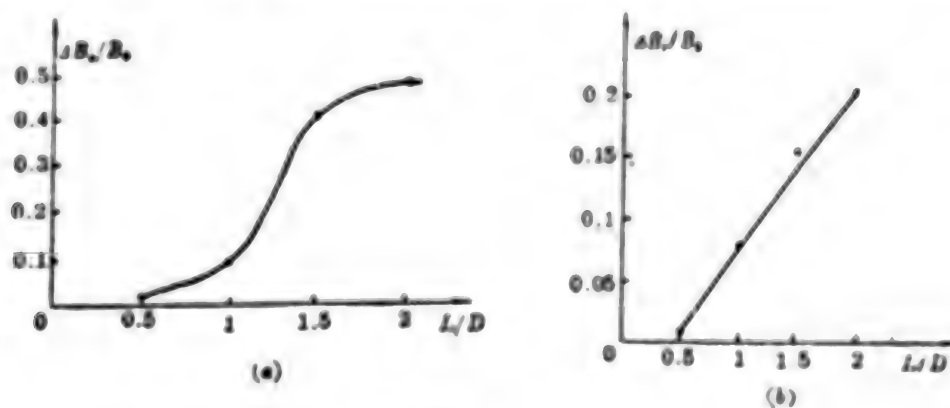


Figure 4

(a) Axial field amplitude B_z (at $r = 0$) vs. L/D ; (b) Radial field amplitude B_r (at $r = 3D/22$) vs. L/D

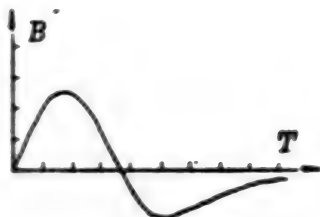


Figure 5. Waveform of measured axial magnetic field

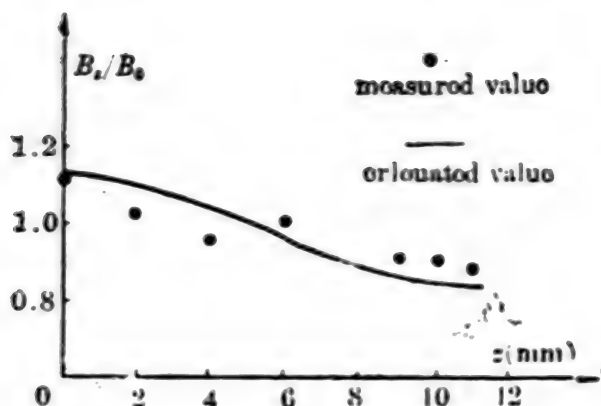


Figure 6. Axial magnetic B_z vs. axial distance z , a comparison between calculation and measurement

IV. Conclusion

Calculations show that the peak transverse magnetic field in an iron wiggler with a period equal to the diameter may reach 8-28 percent of the axial guiding field, and the Raman free electron laser requirement is well satisfied. The actual iron ring wiggler used in the experiments is shown in Figure 7. It is 585 mm long and has a total of 26 periods, with each period equal to 22.5 mm. Under the combined action of the iron ring wiggler and the guidance magnetic field, free electron laser radiation is obtained with a 6 mm diameter solid beam of electrons and with a hollow electron beam 1 mm thick and 16 mm in outer diameter. Typical results are: hollow electron beam energy = 0.5 MeV, beam current = 1 kA, guiding field = 9 kG, laser pulse energy = 13 mJ, width at half maximum of the laser pulse = 25 ns, average power = 0.5 MW, transient electron efficiency = 0.1 percent, and wavelength = 8 mm in the K_α section. Similar electron efficiency was also obtained with the solid electron beam.¹

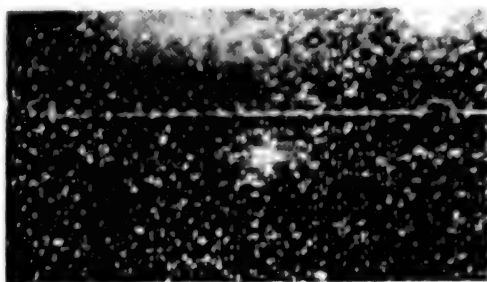


Figure 7. The iron-ring wiggler used in experiments

The authors thank Professor Wang Zhijiang for his guidance and Shi Jinchuan [2457 3160 1556] and Feng Bingfang [7458 3521 5364] for their participation in the experiments.

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CSO: 4008/11

COMPACT, SEALED-OFF TEA CO₂ LASER DESCRIBED

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6, No 9, Sep 86
pp 796-800

[Article by Guo Zhen [6665 2182], Gao Guizhen [7559 2710 3791], and Yu Zhiqi [0205 0037 0967] of the Department of Applied Physics, Northwest Telecommunication Engineering Institute, Xian]

[Text] Abstract: A compact sealed-off TEA CO₂ laser with Kovar-glass envelope for rangefinders has been developed. Using the free-potential electrode corona preionization technique, a compact, rugged, stable and reliable device has been achieved. It has both a long shelf life and operating life.

1. Introduction

CO₂ lasers operating in the 10.6 μ m wavelength range have a greater penetrating power through the atmosphere than 1.06 μ m YAG lasers because the fog and dust particles in the atmosphere are smaller than 10.6 μ m. Furthermore, since they are compatible with front view infrared systems, CO₂ lasers are looked upon as the light source for a new generation of rangefinders. The model CS-1 CO₂ laser is a compact sealed unit developed specifically for this purpose. The unit has a Kovar-glass envelope to preserve the vacuum and a long shelf life.

Good preionization is crucial to the stable operation of the device. Common techniques for ultraviolet preionization include double discharge,² needle arc generator,³ spark array,⁴ and thin tungsten wire. Although these methods provide effective preionization, they are not conducive to miniaturization because complex structural stability is poor and they cannot work reliably in a moving carrier. Some preionization devices also require independent power supply and further complicate the system. In addition, the needle arc is accompanied by severe dissociation of the CO₂ medium and is detrimental to the service life of the sealed device.

The CS-1 TEA CO₂ laser uses a free potential electrode corona preionization technique. It is compact, rugged, stable and reliable. It can withstand 10 g of vibration and can be used in a moving carrier. Tests showed that the pulse rate is less than 10⁻³, the output power fluctuation is less than

± 1 percent, and the service life is as great as 10^6 for a repetition rate of 1-2 Hz and a single pulse output of 120 mJ.

II. Construction and Mode of Preionization

The CS-1 TEA CO₂ laser uses the Chang electrodes¹ with a separation of 7.5 mm and $K = 0.01$. Over a width range comparable to the separation, the relative change of the electric field is less than 10^{-4} . The effective length of the discharge zone is 200 mm. The optical resonance cavity consists of a gold plated total reflection mirror with a 2M radius and a Ge planar half-reflecting mirror. The cavity length is 320 mm.

The CS-1 laser uses a free potential electrode corona (FPEC) preionization technique. Its structure is simple and rugged. It can withstand vibrations and shocks and does not require an independent power supply. The principle and the construction are shown in Figure 1. The FPEC preionization device consists of a pair of parallel metal plates placed on both sides of the main discharge electrode and a dielectric medium of high breakdown intensity between the plates.

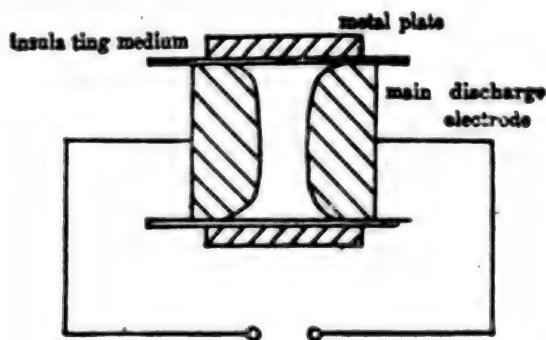


Figure 1

When a high voltage pulse is applied across the main discharge electrodes for several tens of nanoseconds, an extremely strongly electric field suddenly appears between the free potential electrode and the main discharge electrodes. This electric field causes corona to form at the edges of the main discharge electrodes. As the pulse voltage reaches its peak value, the corona quickly spreads along the entire length of the electrode into a wire shaped spark. The wire shaped sparks are uniform in length and evenly spaced. They serve as excellent sources for ultraviolet preionization, as shown in Figure 2.

The length of the wire shaped spark is of importance. Insufficient length cannot provide sufficient preionization and excessive length can cause random shorts across the opposite electrode. When a current short appears across the main discharge electrodes, the current and conductivity increases greatly and causes quenching of the main discharge. Also, the large current flowing along the surface of the medium leaves thermal erosion channels and greatly decreases the breakdown intensity of the dielectric. This phenomenon should therefore be prevented from occurring.

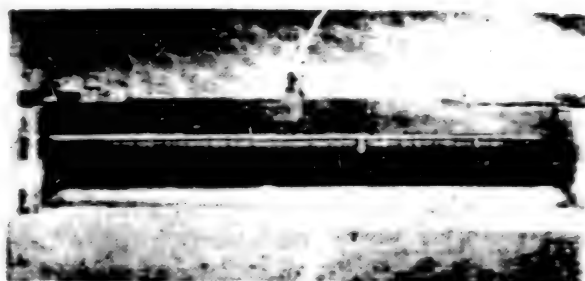


Figure 2

For a given electrode configuration, the length of the wire shaped spark depends on the applied pulse voltage and its rise time. It also depends on the dielectric constant ϵ of the medium, the thickness of the dielectric and the gas composition and pressure at the surface. An empirical formula obtained from the experiments is

$$l = K \frac{\epsilon}{d} \frac{U^2}{P}, \quad (1)$$

where ϵ and d are the dielectric constant and thickness of the dielectric plate, P is the total voltage at the dielectric surface, U is the pulse voltage on the main discharge electrode, and K is a constant dependent on the type of gas. We noticed that K decreases substantially as the size of the gas particles increases and K also depends on the electronegativity of the gas. In our experiments the value of K decreases from He, N_2 , O_2 , to CO_2 .

III. Experimental Results

Our device makes use of a Blumline circuit, shown in Figure 3. The storage capacitor C_1 is $0.01 \mu F$, the spark gap circuit capacitor C_2 is $3300\text{--}4700 \text{ pf}$, and L is 10 nh .

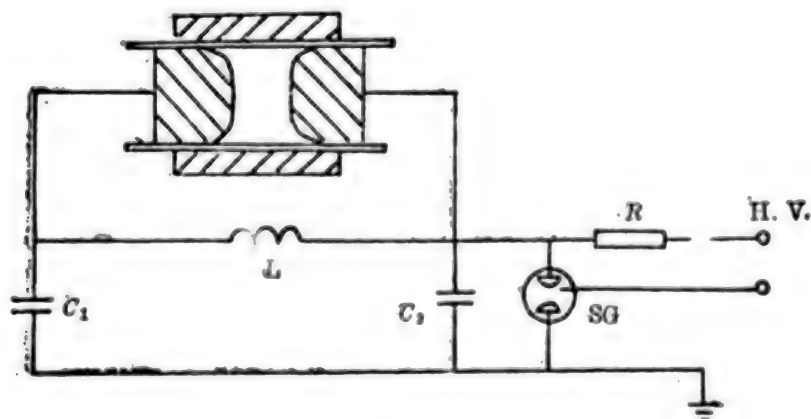


Figure 3

Using a model 7410 photon streak detector we obtained the pulse waveform of the CS-1 TEA CO₂ laser with the standard gas condition. The result is shown in Figure 4 and the pulse width is 50 ns. The standard gas condition is CO₂:N₂:He = 1:1:3 and the total pressure is 1 atm, with trace amounts of H₂.

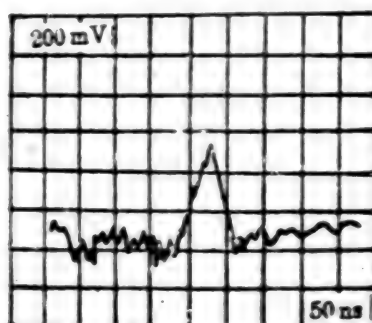


Figure 4

The laser pulse energy is measured using a model ED-500 thermoelectric detector and a Chinese-made LEP-1 power meter. The measuring devices are first calibrated. For the above gas mixture the maximum output is 200 mJ, as shown in Figure 5.

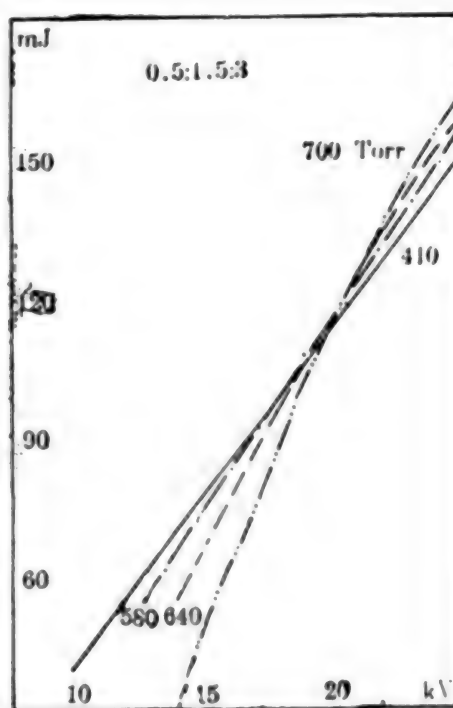


Figure 5

For the best long term stability of the sealed laser, we did not use the gas mixture that gave the greatest output energy. Figure 6 shows some test results of the service life. In the first 8,000 operations the output of the

laser drops to 2/3 of its original output and then approaches a stable value. Monitoring results of the gas composition show that this behavior is consistent with the dynamic equilibrium of the CO₂ decomposition reached after 8,000 operations.

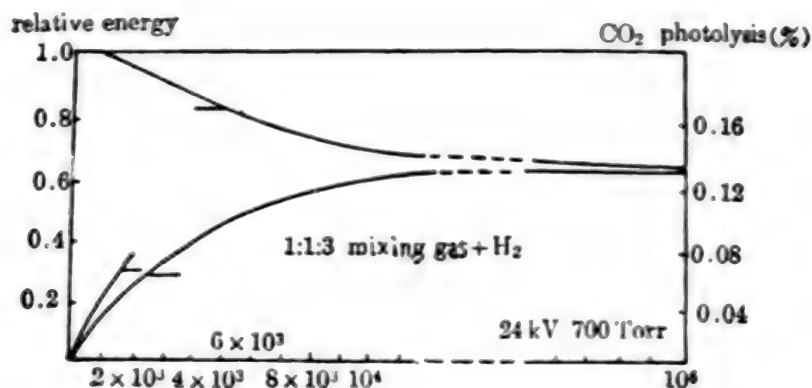


Figure 6

IV. Service Life

In contrast to the gradual degradation of the output of a CW CO₂ laser, the life of a sealed TEA CO₂ laser ends abruptly. After the TEA CO₂ laser has been operated for a certain number of times, the probability for arc discharge suddenly increases, as shown in Figure 7. When the normal uniform glow discharge becomes a local arc discharge, the energy provided by the external circuit can no longer enter the laser medium and the laser output decreases abruptly.

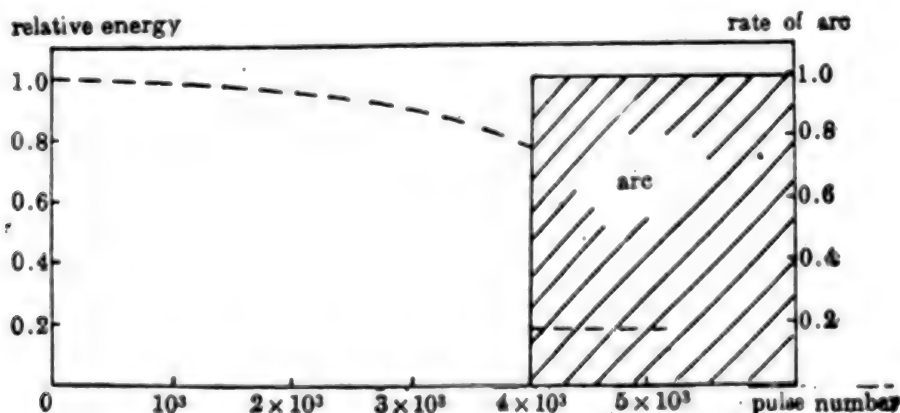


Figure 7

The sudden death of the TEA CO₂ laser indicates that it has a different mechanism than the CW CO₂ laser. In order to prolong the service life of a TEA CO₂ laser and to improve its discharge stability, the decomposition of CO₂ must be reduced to decrease the concentration of the negative ions. We

found that the addition of a small amount of H_2 is very necessary. The H_2 combines with the O^- and also helps to reduce the decomposition of CO_2 .

Smith⁷ and Shields⁸ have studied the effects on the performance of a TEA CO_2 laser by mixing small amounts of CO and H_2 in the 1:1:3 gas mixture. Shields observed in his experiments that the addition of H_2 reduced the CO_2 decomposition. However, since he had frequent arcing after 2400 operations, he was unable to obtain the dynamic equilibrium decomposition. His experimental results are quite different from ours. When we added 5 percent of H_2 , we obtained 10^6 times of uniform glow discharge before we had arcing. We also did not find any appreciable decrease of the laser output after the H_2 addition. When Smith added 10 percent of CO , the energy density decreased from 6 J/l to 2.5 J/l. We believe that the addition of H_2 has no reason to decrease the laser output. The effect is at least partly due to the H_2O molecules formed in the $H_2 + O^- \rightarrow H_2O + e$ reaction. H_2O is very effective for the relaxation of the final energy level $01'0$ of the laser; it therefore helps to compensate the relaxation effect of H_2 molecules on the upper energy level of the laser.

The authors acknowledge the participation of Wen Jianguo [2429 1696 0948] and Cai Defang [5591 1795 5364] and thank the assistance given by the Zhongyuan Institute of Electronic Technology and the Hongguang Electron Tube Plant of the Ministry of Electronic Industry.

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9698/6091

CSO: 4008/11

APPLIED SCIENCES

ENGINEERING SEISMOLOGY LEVEL SAID AMONG WORLD'S MOST ADVANCED

OW081907 Beijing XINHUA in English 1538 GMT 8 Nov 86

[Text] Beijing, 8 Nov (XINHUA)--China now has set up about 760 earthquake prediction and forecast networks of different types at the state, local, and enterprise levels, with 15,000 seismologists and trained non-specialists working across the whole country.

XINHUA learned this from the "national exhibition on quake science and technology" currently being held here.

The exhibition displays China's 20-year research and work achievements in earthquake prediction, engineering seismology, research, development and application of new technology, quake prediction and disaster prevention, countermeasures and international cooperation.

In 1956 quake prediction was put on the list of the state science and technology development program. In 1966, after the Xing Tai earthquake in Hebei Province, China launched large-scale work on earthquake prediction, prevention and rescue.

In 1975 China made an accurate prediction of the 7.3-magnitude tremor which hit Haicheng in Liaoning Province, saving 100,000 lives and avoiding an economic loss estimated at about one billion U.S. dollars. This was the first accurate prediction of a seven-magnitude quake in the world. The successful prediction of the songpan tremor in Sichuan Province in 1976 provided useful experience for the kind of tremor that had no pre-quake warning.

"China's engineering seismology is among the world's most advanced," said an official at the exhibition.

A 6.1-magnitude tremor occurred near the Xinfengjiang reservoir on the upper reaches of the Pearl River in Guangdong Province in '961. Thanks to timely reinforcement of the dam, a collapse was avoided and severe damage to Guangzhou city on the lower reaches was avoided. This was the first engineering project to successfully withstand a quake in the world.

In designing a reservoir and a power station on the middle reaches of the Yellow River, China saved about 100 million U.S. dollars because of accurate estimation of the local seismic conditions.

The exhibition also explained why a pre-quake prediction of the 1976 Tangshan earthquake was not made. The main attribution was that the Tangshan quake gave off no obvious pre-quake warning until within 24 hours of the disaster, which eventually claimed 240,000 lives.

The official said, "pre-quake prediction is one of the most difficult problems to solve and seismologists around the world are making unflagging efforts in this regard."

The exhibition, sponsored by the state seismology bureau, opened October 18 and will run for a month.

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CSO: 4010/16

APPLIED SCIENCES

VISIT TO BEIJING REMOTE SENSING STATION DETAILED

HK260857 Beijing BAN YUE TAN in Chinese No 21, 10 Nov 86 pp 33-35

[Article by Chen Ming (7115 6900): "China Enters the Era of Satellite Remote Sensing -- A Visit to the Beijing Remote Sensing Satellite Ground Station"]

[Text] Modern satellite remote sensing technology represents an important, sophisticated area in contemporary space technology. Using satellites to observe the earth has tremendously broadened our field of vision and increased our understanding of the earth we live on. This is of great significance to the development and progress of economy, science, and technology. It is also extensively applied in agriculture, forestry, geology, oceans, petroleum, and urban planning.

China has studied satellite remote sensing since the mid-seventies. After 2 years of hard work, it succeeded last June in building a remote sensing satellite ground station, which is up to world standards of the 1980's. This is one of four advanced remote sensing satellite stations in the world. It indicates that China's space remote sensing technology has developed from the era of aerial remote sensing to one of satellite remote sensing.

Recently, this reporter visited the remote sensing satellite ground station situated at the norther foot of Yan Shan in Beijing. In his briefing, Zhang Libing, deputy director of the Science and Technology center of the Chinese Academy of Sciences, said: Covering an area of 40 mu, the remote sensing satellite ground station is a Sino-U.S. space science and technology cooperative project signed by Deng Xiaoping during his visit to the United States in 1979. Its principal equipment was imported from the United States. Since its trial operation last June, it has been running well and has started processing data and pictures collected by satellites. According to the appraisals of the heads of remote sensing satellite ground stations in various countries, the quality of the satellite pictures produced by [garble] has reached a first-grade world level.

In the courtyard of the ground station, which was planted all over with flowers, a cream-colored antenna, 13 meters high and with a diameter of 10 meters, looked especially spectacular. The giant antenna facing the vast blue sky is an "eye" with which people track and control artificial satellites. It raises people's viewing angle from the ground to outer space. According to the briefing, the ground station can receive satellite data over a fairly wide area which, with Beijing as the center, covers the Sino-Soviet and Sino-Mongolian borders in the north, the Sino-Vietnamese and Sino-Burmese borders in the south, Hainan Island, the coastal areas in the southeast, Taiwan, and the Penghu area. In the control center, this reporter witnessed a scene of tracking and receiving by the ground station: Following the slow movement of the outdoor antenna, the ground station obtained in only 12 minutes a scan of all data about a belt of the earth's surface covering an area 5,400 km long and 185 km wide. It included the geographical and geomorphological features of the Soviet Baykal Lake, the Sino-Mongolian border, Qinghai's Xining, and the Sino-Burmese border. A responsible person of the station office explained: The installation of a multispectral scanner enables the satellites to expand their viewing range from visible light to infrared and far infrared rays. It can distinguish between soil and vegetable and between coniferous and broadleaved forests; measure the green reflection peak of plants and estimate the way a crop is growing; and distinguish plants of different kinds and rock of different types and prospect for non-renewable resources, such as oil and mineral deposits.

According to some foreign estimates, 70 percent of the maps of the world do not provide sufficient data and the remaining 30 percent provide outdated or inaccurate data. It would take 50 years to update the maps of the globe with traditional surveying and mapping methods. Some areas are even inaccessible to man. The use of satellite graphic data can reduce the amount of surveying and mapping work by 90 percent. In the satellite data processing center, this reporter saw a color satellite picture of the Beijing area. Measuring 1 meter square, the picture clearly showed the rectangular Tiananmen Square. Even the city moat surrounding the Imperial Palace can be seen clearly.

A member of the working personnel said: "Since its trial operation, the ground station has received and processed more than 400 satellite pictures. Some of them have been applied in production and construction." In the great battle for the building of Shanglei oilfield in Bo Hai, into which the Huang He empties, we used satellite pictures to work out plans for changing the river's course. Instead of exploiting offshore oil, we decided to exploit onshore oil. These changes in construction projects alone can reduce investment by several hundred million yuan. The rate of correctness was as high as 95 percent when Beijing Agricultural University used satellite pictures to survey the wheat-growing areas in Beijing's Shunyi and Tong Counties and their output. In the past, however, the error-rate was always more than 20 percent when it employed regular methods. From 1980 to 1983, we made use of 560 satellite pictures of land and topography to calculate the area of the country and of its various provinces, to work out a picture

of the current use of land throughout the country, and to ascertain for the first time the distribution and area of cultivated land, thus supplying a large amount of scientific data for the development of China's industry and agriculture.

At the end of the visit, with full confidence the responsible person of the ground station told this reporter. Satellite remote sensing technology has various advantages, such as large areas of observation, high speed and accuracy, synchronous repeated observation at regular intervals, freedom from regional restrictions, economy, and substantial benefits. An indispensable means of promptly obtaining information about natural resources and the environment in today's information society, it has broad prospects for development. The Beijing Remote Sensing Satellite Ground Station will be officially commissioned in November this year. When that time comes, it will make contributions to China's economic construction and scientific development by supplying the remote sensing application departments and the scientists and technicians throughout the country with various satellite pictures and data in an endless stream.

/12624

CSO: 4008/21

BRIEFS

METEOROLOGICAL SATELLITE LAUNCH--Beijing, 20 Nov (XINHUA)--China will launch a meteorological satellite as part of its plan to develop a series of earth observation satellites, the overseas edition of the PEOPLE'S DAILY reported today. "In addition, an earth resource satellite and an ocean observation satellite are being developed," Wang Xiji, an official from the Chinese academy of space technology, said in the report. Wang said, "China has already successfully launched some earth observation satellites including those for land survey, scientific exploration and technical experimentation." "China has sent up 19 satellites since 1970, and most of them are for earth observation," Wang added. The use of space remote sensing technology has been expanded to many fields in China's economic development, including land survey, geological prospecting, water conservation, city planning and harvest estimation, the paper said. [Text] [Beijing XINHUA in English 0658 GMT 20 Nov 86 OW] /12624

NATIONAL SEISMOLOGICAL MAP DRAFT--Haikou, 27 Nov (XINHUA)--China will soon begin to draft the country's third seismological chart to help people guard against earthquakes. The state seismological bureau held a national meeting here this week to arrange a nationwide cooperation network for the job. China drafted seismological charts in the 1950s and 1970s. But with the changing geological conditions, some parts of these two charts are out of date, an official from the bureau told XINHUA. To ascertain more specifically zones of earthquake intensity, scientists made some tests in the north part of Hainan Island. The new map will also be based on years of surveys and analyses and will demonstrate the advanced techniques of Chinese scientists in earthquake monitoring, he said. [Text] [Beijing XINHUA in English 0134 GMT 28 Nov 86 OW] /12624

CSO: 4010/16

INFLUENCE ON CHROMOSOMAL ABERRATION, SISTER CHROMATID EXCHANGES IN CELLS BY 3 COMPONENTS OF PINGYANGMYCIN

Beijing YICHUAN [HEREDITAS] in Chinese Vol 8, No 2, Mar 86 pp 28-30

[Article by Wang Qinnan [3769 2953 0589]; Fei Yunbiao [6319 0061 2871] presently at the Institute of Developmental Biology, Academia Sinica; Shen Guangping [3088 0342 1627]; and Song Haiyan [1345 3189 3601], all of Institute of Genetics, Academia Sinica, Beijing; paper received on 28 Sep 1984]

[Text] This paper reports on further studies of the antitumor drug pingyangmycin (PYM), which, in addition to inducing chromosomal aberrations in higher plants [1], can also induce such aberrations in mammalian cells and increase the frequency of sister chromatid exchange (SCE) [2]. The present research go beyond studies of chromosomal aberration and SCE testing to further explore the effect of three components of PYM, A_2 , A_5 , and A_6 , on chromosomal aberration, and the frequency of sister chromatid exchange in CHO-K1 cells.

PYM and bleomycin (BLM) are both derived from the genus Streptomyces verticillus. Their chief components are 10 different glycopeptides, compounds with an identical chief nucleus, but a different terminal amine. Both PYM and BLM are found to contain A_2 , A_5 , and A_6 . The chief component in PYM is A_5 , about 60 percent; the chief component in BLM is A_2 , about 50-70 percent [3, 6]. For this reason, PYM belongs to the bleomycin family of compounds. To understand the characteristics of PYM influence on chromosomal aberration, one must study in depth, the effect of its various components on chromosomal aberration and SCE frequency.

Materials and Methodology

1. Cell Culture

Corresponding numbers of growing CHO-K1 cells are inoculated (at 2×10^5 cells/ml) onto Eagle's culture medium containing 10 percent bovine serum, then placed in CO₂ incubator at 37 degrees centigrade for 24 hours.

2. Chemical Testing Agent

After a 24-hour culture period, the cells are treated individually with 0.2, 0.4, and 1.0 mcg/ml of A_2 , A_5 and A_6 in culture medium, each treatment containing 10 mcg/ml BrdU, for 12 hours. Cells treated with 10 mcg/ml BrdU only, serve as the control group. Subsequent tests with the culture medium containing BrdU are repeated at 37 degrees centigrade for 40 hours. Four hours before harvesting, colchicine is added. The final concentration used is 0.4 mcg/ml, to allow for more metaphases.

3. Preparation of Specimens

After treatment of materials has been completed, the culture flask is shaken, and suspended cells are gently removed with pipette and centrifuged at 500 g for 10 minutes. Precipitated cells undergo low percolation with 0.075 M KCl at 37 degrees centigrade for 8 minutes, and fixed twice, 10 minutes each time, with 3:1 strength of methanol:glacial acetic acid. Slides are prepared with the cold drop method, then air-dried.

4. Staining and Fixing

Specimens that have been air-dried and aged for over 24 hours are placed in 1.0M of NaH_2PO_4 solution (pH8) to undergo dissociation bath at a constant temperature of 89 degrees centigrade, then washed with double-distilled water before staining with Giemsa solution (3 ml undiluted Giemsa dye to 97 ml double-distilled water) at 20 degrees centigrade for 3 minutes. After drying, Canada glue is used to fix stain.

Because of the BrdU in DNA, daughter chromatids from the post-treatment second division cycle are Giemsa-stained lighter [16], which clearly identifies the metaphase cells during the first and second cycles of mitosis after treatment. The result is that on the same specimen, one can identify the pattern of chromosomal aberrations and SCE frequencies from the two cycles [21].

Results and Discussion

Results of the experiment show that A_2 , A_5 , and A_6 , the three components of PYM, can all induce mammalian chromosomal aberrations (Plate I), the strength of their influence being $A_6 > A_5 > A_2$. When concentration of the component-treated solution was at 0.2 mcg/ml, distribution of the induced chromosomal aberration frequencies are noted as A_2 , 9 percent; A_5 , 12 percent; A_6 , 15 percent; and control, 2 percent. Within scope of the test concentrations, the cell aberration frequency of all treated groups increased with a corresponding rise in concentration of test solution (Table 1), and the frequency of induced SCE also increased with a rise in test solution concentration (Table 2).

Chromosome-Type Aberrations

The comparatively low chromosome-type aberrations (50 percent) following the first cycle of mitosis in the cell group treated with high concentration A_2 (1.0 mcg/ml) may be due to the fact that large-dose treatment prolonged the cell cycle so that mitosis was inhibited to the extent that chromosomal-type

aberrations were not fully expressed. Among various aberrations in the other treated groups, the proportion of chromosome-type aberrations was highest--over 70 percent (see Table 1). Isotope labeling has proven that the chief cause of this phenomenon is the massive infusion of A_2 and A_5 from BLM during the catabolic process into DNA of cells in their G_1 phase, with only a small distribution to cells in S and G_2 phases [7, 23]. It is obvious that A_2 and A_5 exert an effect on the cell in G_1 phase. Later on, Liu Fritu [2692 1920 0956] et al [5] used autography on esophageal cancer cells to study the mechanism of A_2 action, the results of which also confirmed the aforementioned facts. At the same time, many studies show that characteristics of aberrations induced by the BLM family of compounds are those associated with nondependent S-phase compounds [9, 14]. Called misrepair, this mechanism is due to the breakdown in normal function during repair of DNA damage, or to some error occurring during the repair process. Damage occurring during the G_1 phase of mitosis often show up with chromosome-type aberrations, and that occurring during S and G_2 phase frequently show up with chromatid aberrations [13].

Treatment ($\mu\text{g/ml}$)	Metaphase cells	Chromosome-type Aberrations				Chromatid-type Aberrations				Nucleoli	Total ¹⁾	
		D ²⁾	B ³⁾	4)	L ⁵⁾	B ³⁾	T ⁶⁾	N ⁷⁾	G ⁸⁾		No.	%
A_2 BrdU												
0.2 10	100	5	2				1	1			9	9
0.4 10	100	7	4			2	1				14	14
1.0 10	100		3	2	3	4	4			1	17	17
A_5												
0.2 10	100	3	4	1	1	2				2	14	14
0.4 10	—	—	—	—	—	—	—	—	—	—	—	—
1.0 10	100	3	2		2	2				8	17	17
A_6												
0.2 10	100	3	6			4		1	1	1	16	16
0.4 10	100	2	6	1	2	3		1	1	2	18	18
1.0 10	100	3	5			3				8	19	19
CK 10	100				1		1			1	3	3

Table 1. Effect of three components of pingyangmycin on chromosomal aberrations in CHO cells.

Key:

- 1) Number of cell aberrations in the first cycle of mitosis following treatment.
- 2) D, disintegrations.
- 3) B, breaks.
- 4) P, double strand points.
- 5) L, loops.
- 6) T, translocations.
- 7) N, deletions.
- 8) G, gaps.

Moreover, double minutes (DM) were also seen in cells showing aberrations (Plate I, a). The existence of double minutes is an indicator of cell undergoing cancerous change [15, 18, 19, 22]. In other words, PYM can cause cancerous change in mammalian cells, a topic to be discussed in a separate report.

Chromosome Disintegration

Test compounds also induced a large amount of chromosomal disintegration (see Table 1). This phenomenon is due to the high degree of chromosomal breakdown that leads to dissolution, a characteristic infrequently seen in its inducer. Ohama et al., [24] had reported on the disintegration phenomenon. Following this, Muller et al., [23], and Haidle et al., [10], discovered that low concentrations of BLM can cause a separation of thymidine from the DNA chain resulting in single-chain break; at high concentrations, four nucleosides separate from the DNA chain, leading to multiple breaks in the double chain. Later on, Kuo [17] recognized that BLM can cause dissociation of the nucleomicrosomal junction, and as this kind of junction has an important effect on tight winding of chromatin, it is followed by chromatin dissolution during replication. It has been proven by others that disintegration occurs in chromosomes during the G_2 phase. This explains the even greater sensitivity [11] of cells to mutation-inducing factors during this stage. Basically, disintegration also expresses the differences in sensitivity of various chromosomal parts to outside factors. Results of our experiment demonstrate that whether it is the A_2 , A_5 or A_6 N causing alkylating separation or dissolution in the nucleomicrosomal junction, disintegration always occurs in the end.

Nucleoli

During our experiment, large quantities of nucleoli appeared in cells treated with high concentrations (1.0 mcg/ml) of A_5 and A_6 , comprising 47 percent and 42 percent respectively, of their totals. This explains the chromosomal breakage they induced, which resulted finally in the large numbers of nucleoli. The very low frequency of nucleoli being induced by test compounds of lower concentration (see Table 1) may be due to easier DNA repair because of less DNA damage, which also results in a decrease in the number of nucleoli. These results are consistent with those from similar tests on the induction of nucleoli in plant cells.

Sister Chromatid Exchange (SCE)

During the second cycle after treatment, the frequency of SCEs caused by the three components of PYM rises with corresponding increases in the concentration of the treatment solution (see Table 2). Their t values are noted as 0.07, 3.75, and 6.15 for A_2 ; for A_5 , 4.30, 8.11; and for A_6 , 2.85, 7.26, and 8.76. Except for the group treated with 0.2 mcg/ml of A_2 , the difference between the remaining groups and controls are very marked. Comparing a rise in chromosomal aberration frequency and an increase in the SCE frequency shows no correlation, because SCE formation does not depend on the elimination of DNA damage. On the other hand, damage does not necessarily encourage SCE formation [12, 20, 25, 26].

Treatment ($\mu\text{g/ml}$)		Meta- phase cells ¹⁾	Cell aberra- tions	Chromosomes/ cell	Sister Chromatid Exchanges		t value ²⁾
					Each meta- phase cell	Each chromosome	
A ₁ BrdU	0.2 10	99	3	19.32 ± 0.58	4.97 ± 0.25	0.26 ± 0.13	$0.07P > 0.01$
	0.4 10	100	6	19.25 ± 0.71	5.98 ± 0.21	0.51 ± 0.11	$3.75P < 0.01$
	1.0 10	100	4	19.28 ± 0.79	6.84 ± 0.24	0.36 ± 0.12	$6.15P < 0.01$
A ₂	0.2 10	100	4	19.08 ± 0.95	6.17 ± 0.21	0.32 ± 0.11	$4.30P < 0.01$
	0.4 10	—	—	—	—	—	—
	1.0 10	100	9	19.56 ± 0.57	7.59 ± 0.23	0.59 ± 0.12	$8.11P < 0.01$
A ₃	0.2 10	99	8	19.40 ± 0.73	5.67 ± 0.19	0.29 ± 0.09	$2.85P < 0.01$
	0.4 10	100	4	19.48 ± 0.63	7.27 ± 0.22	0.37 ± 0.12	$7.26P < 0.01$
	1.0 10	100	7	19.34 ± 0.56	7.86 ± 0.25	0.40 ± 0.13	$8.76P < 0.01$
CK	10	100	2	19.29 ± 0.73	4.75 ± 0.16	0.25 ± 0.08	

Table 2. Effect of three components of pingyangmycin on chromosomal abnormalities and sister chromatid exchanges in CHO cells.

Key:

1. Number of cells in second cycle of mitosis following treatment.
2. Calculation of t values based on the number of SCE in each metaphase cell.

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DETECTION OF YEAST INVERTASE BY PAPER REPLICA TECHNIQUE

Beijing YICHUAN [HEREDITAS] in Chinese Vol 8, No 2, Mar 86 p 31

[Article by Li Xiexun [2621 6168 8113] and Li Yuyang [2621 5148 7122], Institute of Genetics, Fudan University, Shanghai; article received 18 March 1985]

[Text] An important part of the research problem facing genetic engineering and cloning techniques is establishing a sensitive screening method. Using flat plate culture detection to conduct preliminary screening in the cloning process is one of the simpler methods.

Yeast sucrase (invertase) can hydrolyze sucrose into fructose and glucose. This enzyme is found intracellularly within the cell, or in the cell's peripheral spaces between the cell membrane and the cell wall. The first step in detecting invertase activity requires separate culture of yeast cells which must be broken up, after which the glucose content of the extract is determined. In our experiment studying the cloning and expression of the SUC2 gene in yeast, we devised a paper replica technique to detect yeast invertase. The technique is very sensitive and can quickly detect whether or not invertase is being produced during the yet-to-be assayed cloning process (data to be published). The results are consistent with those from experiments where Hackel's method [1] was used to determine invertase activity.

The method we used is described as follows:

An agar culture medium (2 percent albumen peptone, 1 percent powdered yeast, 0.05 percent glucose) is poured into a 9-cm diameter flat plate, and the to-be-assayed clone product is smeared onto the flat plate and cultured at 30 degrees centigrade for 1-2 days. The plate is then opened, and a piece of sterile filter paper, about 8 cm in diameter, is spread over the cultured colonies. The flat plate is then placed inside a glass jar, 12 cm in diameter and 8 cm deep, to which chloroform has been added to a depth of 1 cm, then closed tight. The jar is now placed in a 30-degree centigrade water bath which gradually releases the invertase that has been adsorbed onto the paper. After 30 minutes, the filter paper is removed from the flat plate, and any residue chloroform left on the paper vacuumed off. The paper is then placed into a 12-cm flat plate to which 30 ml of 0.1M sucrose and 0.1M pH4.5 sodium acetate solution have been added, to undergo enzymatic reaction at 30 degrees centigrade. After 15 minutes, the paper is taken out and any residue solution

on the paper's surface is blotted off with dry filter paper. Paper is then placed into a 30-ml solution of 0.5N sodium hydroxide containing 0.25 percent 2,3,5-triphenyl tetrazolium chloride in a flat plate, for color development. After this, paper is placed in boiling water bath for several minutes, until red spots appear on the paper. It is taken out immediately and quickly rinsed with clear water. All yeast with active invertase will show up as rosy red spots; those colonies without invertase will not show coloring (see Figure 1). After paper has been dried, it is stored away.

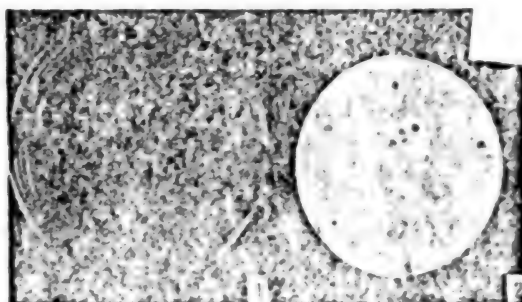


Figure 1. Determination of yeast invertase activity with paper replica technique.

Key: 1. Yeast colonies that are replicated.
2. Paper after color development.

The advantages of the method we have devised are speed of enzyme appearance and the simple procedure which does away with the cumbersome steps involved in flask-shaking during the screening phase. At the same time, because the enzymatic reaction that is activated in this method is directly coupled to the chemical reaction that produces the nonsoluble red product, specificity is especially strong.

By changing the enzymatic system, this technique can be used to detect the presence of maltase, melibiase, amyloglucosidase, and beta-glucosidase. If nitrotetrazolium chloride is used as the color developing agent, the technique then can be used to detect such dehydrogenases as lactate dehydrogenase, malate dehydrogenase, citrate dehydrogenase, and glutarate dehydrogenase. One can also use this flat plate technique to detect mutant strains of E. Coli, yeast etc., that lack or have lost enzyme activity. Finally, it can be used as a preliminary screening technique for selecting active yeast strains in the study of microorganism genetics.

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CSO: 4008/1114

DISTRIBUTION OF AFLATOXIN B₁-INDUCED SISTER CHROMATID EXCHANGE FREQUENCY IN HUMAN CHROMOSOMES

Beijing YICHUAN [HEREDITAS] in Chinese Vol 8, No 2, Mar 86 pp 38-40

[Article by Xu Xuefang [1776 7185 2455], He Fangfa [0149 2455 3127], Chou Xueyou [6650 1332 0327], Zhang Puili [1728 0160 5461], and Yu Xinsheng [7411 2450 3932], all of the Shanghai Institute of Oncology, Shanghai; article received 20 Jun 1984]

[Text] When tumors are induced by chemical carcinogens, the cancerous gene is not introduced into the cancerous cell. Rather, the carcinogenesis process is the result of interaction between the chemical carcinogen and the gene within the target cell [7]. Aflatoxin B₁ (AFB₁) may be one of the chief causes of liver cancer [1]. Animal experiments have shown that AFB₁ can induce liver cancer, and instances of chromosome aberration and sister chromatid exchange (SCE) induced by AFB₁ in in vitro cell cultures are increased markedly, in direct proportion to the concentration of the chemical agent [2].

At present, SCE is being used widely to detect and measure mutagens and carcinogens. Our laboratory has used this technique to conduct three in vitro experiments, and analyzed the distribution frequency of 1644 AFB₁-induced SCEs in chromosomes of peripheral lymphocytes from normal individuals. The results show that the number of AFB₁-induced SCEs is markedly greater than that in the control group, and distribution of SCEs on each chromosome is mostly spontaneous, though it shows a selective increase in the 5th chromosome.

Materials and Methodology

1. Cell Culture

Materials for in vitro culture and study consisted of peripheral lymphocytes from 11 healthy individuals (7 males, 4 females): 4 in experiment I, 4 in experiment II, and 3 in experiment III. The SCE study technique followed that previously reported [2]. Whole blood of participants and AFB₁ (British import, Sigma Co.) were added simultaneously to RPMI 1640 culture medium containing 5-BrdU (final concentration 9 mcg/ml), 15 percent bovine serum, and 200 mcg/ml PHA. When the final concentration of AFB₁ was noted at 0.04 mcg/ml, culture was placed in darkness to incubate for 72 hours. Colchicine (final concentration 0.02 mcg/ml) was added 2-4 hours before chromosomes were

harvested. After cells had been immersed in 0.075M KCl at 37 degrees centigrade for 15 minutes, the culture was ready for fixation and slide preparation. Under ultraviolet light, the slides were immersed in 2 X SSC at 60 degrees centigrade for 15 minutes, after which they were Giemsa (2.5 percent)-stained. Another culture was prepared in the same manner without the addition of AFB₁, for normal controls. In experiment II, a combination of G-banding and SCE was used. Glass slides were placed in 2 X SSC and incubated at 60 degrees centigrade for 17-20 hours before Giemsa-staining. At the same time, chromosomes showed G-banding and SCE (Figure 1).



Figure 1. Simultaneous appearance of G-banding and SCE during mitosis.

2. Analysis of SCE Sites

Most work done so far on this topic shows that distribution of spontaneous SCE from normal lymphocytes (of normal individuals) on different chromosomes is directly related to chromosome length and DNA content, and follows a Poisson distribution [5]. Smith et al. [6] have used G-banding and autoradiography to determine the sites of 611 SCEs, with the same results. For this reason, our experiment selected the metaphase cell during mitosis for electromicrographs,

when SCEs are noted most clearly, and following international standards for a G-band chromosome model, performed nuclear analysis. The frequency of SCEs on long and short arms of each chromosome was counted. Then assuming the relative length of chromosomes (Danforth-London system) as the predicted value of SCE on chromosome x during random distribution,

the SCE predicted value for chromosome x

= total number of SCEs X (chromosome x L /total chromosome L)

where L = length, we checked and tested each calculation with actual observations, and compared them with results from the control group.

Experiment Results

1. In our three experiments, the SCE values of normal lymphocytes after treatment by 0.04 mcg/ml AFB₁ showed a marked increase (Table 1).

Experiment	AFB ₁ Conc.	Obs. chr.	Total SCE	SCE/chr.	t val	P val
Exp. I	0*	644	69	0.107	4.13	0.001
	0.04	4600	786	0.170		
Exp. II	0*	564	54	0.096	2.41	0.05
	0.04	2729	363	0.133		
Exp. III	0*	2576	235	0.091	10.39	0.001
	0.04	2576	495	0.192		

Table 1. Comparison of SCE frequencies in normal lymphocytes treated and not treated with AFB₁.

* Denotes the control group; Conc. = concentration; Val = value

Obs. chr. = number of chromosomes observed; SCE/chr. = SCE/chromosome

2. The SCE frequency on the 5th chromosome during treatment with AFB₁ showed a very marked increase. Results of three experiments all showed this marked effect (Table 2).

Group	Exp.	5th Chromosome			Long Arm			Short Arm		
		I	II	III	I	II	III	I	II	III
AFB ₁ Exp.	Pd no.	41.32	22.25	30.34	30	16.16	22.03	11.32	6.09	8.31
	Ob no.	72	40	95	53	21	55	19	19	40
	x ² val	24.27**	15.9**	135.7**	18.72**	2.43*	47.8**	5.61*	15.8**	117.0**
Control	Pd no.	3.38	3.31	14.4	2.45	2.4	10.45	0.93	0.91	3.95
	Ob no.	3	2	13	3	1	5	0	1	8
	x ² val	0.047	0.55	0.056	0.13	0.88	2.34	1	0.07	3.19

∴ *P<0.05, **P<0.001

Table 2. Frequencies of SCE distribution on the 5th chromosome.

Pd no. = predicted number; Ob no. = observed number; x² val = x² value.

3. The AFB₁-induced SCE increase was non-random (not spontaneous). Individual analysis of three samples during experiment III showed SCE selectivity distributed on the 5th chromosome (Table 3), which differed markedly from that in the controls.

	5th Chromosome		Long Arm		Short Arm	
	Exp. Group	Control Gp.	Exp. Group	Control Gp.	Exp. Group	Control Gp.
	Pd no. Ob no.	Pd no. Ob no.	Pd no. Ob no.	Pd no. Ob no.	Pd no. Ob no.	Pd no. Ob no.
1st S x ² val	9.56 32 50.35**	3.19 3 0.03	6.94 26 49.64**	2.32 1 0.28	2.62 6 3.16	0.87 2 0.45
2nd S x ² val	8.77 24 24.74**	5.33 2 1.5	6.37 13 5.9*	3.97 0 2.93	2.4 11 27.34**	1.46 2 0.001
3rd S x ² val	12.0 39 38.13**	6 5 0.37	8.72 16 5.27*	4.36 4 0.004	3.29 23 112.1**	1.64 4 2.11

* P<0.05 ** P<0.001

Table 3. Distribution of SCEs on the 5th chromosome in three samples.

Pd no. = predicted number; Ob no. = observed number;
1st S = 1st sample; 2nd S = 2nd sample;
3rd S = 3rd sample; x² value = x² value.

Discussion

1. AFB₁ Dosage and SCE Response

SCE is a highly sensitive indicator for understanding chromosome damage and subsequent chromosome repair. At present, this has been used extensively to

detect mutagens and carcinogens. Aflatoxin B₁ is a chief cause of liver cancer. In vitro, a 0.02 mcg/ml dose can induce an increase in SCEs which is in direct proportion to the AFB₁ dose

$$\text{gamma} = 0.821583 \quad [2]$$

In cells of the genetically susceptible, the number of SCEs will rise with a 0.01 mcg/ml dose. To further study whether the SCEs induced by AFB₁ after chromosomal damage is random or specific, we have used a dosage of 0.04 mcg/ml AFB₁ for our analyses. Table 1 explains that results of all three experiments show AFB₁ can induce a rise in SCEs, which differs markedly from results from the controls--proof that it is a strong mutagen. Because the peripheral blood used in all three experiments came from different individuals with different degrees of susceptibility, the SCE values also differ; but compared with those from the controls, these values are still significant.

2. Non-randomness of AFB₁ Inducing SCE

Even though the mechanism of SCE is not fully understood, use of SCE to detect and determine chromosome damage by mutagens is well recognized. In experiment I, of all SCEs induced by AFB₁ in lymphocytes from four normal individuals, cell nucleus typing was used to analyze the distribution among chromosomes of 786 SCEs. Preliminary determination showed an unusual rise of AFB₁-induced SCEs on the 5th chromosome. In experiment II, a combination of G-banding and SCE was used to preliminarily ascertain that the marked difference in SCE was on the 5th chromosome. Experiment III again analyzed the AFB₁-induced SCEs from lymphocytes of three individuals which showed the same noticeable selectivity on the 5th chromosome. Because of differences between individuals, it holds that there is variation in the SCE values, which, basically, are quite significant.

Varied Localization of Damage to Chromosomes by Different Mutagens

Studies by Brogger [4] showed that SCEs induced by mitomycin C (MMC) tended to form in the sites of 1q12, 9q12, and 16q11, but it was not possible for the monofunctional alkylating agent methyl methane sulfonate to increase the SCE frequencies in these sites. In our experiment, the AFB₁-induced SCEs were located primarily on the 5th chromosome.

To determine the relationship between carcinogens and chromosomal abnormalities. Yunis [8] had studied confirmed chromosomal abnormalities in the 5th, 6th, and 8th chromosomes from patients suffering from primary and recurring acute nonlymphocytic leukemia who had been exposed to mutagenic agents. Our group had also analyzed the SCEs of lymphocytes from liver cancer patients, and discovered a marked rise in SCEs in the 7th, 8th, and 12th chromosomes (this report is yet to be published), which corresponds to the aflatoxin B₁ induced SCE distribution selectivity and rise on the 5th chromosome. Even though it is an in vitro experiment, the cytological basis of a definite causal relationship between AFB₁ and liver cancer it suggests is worth exploring.

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CSO:4008/1114

ENVIRONMENTAL QUALITY

NATIONAL CONFERENCE STRESSES TOXIC WASTE CONTROL

OWO41242 Beijing XINHUA in English 1116 GMT 4 Oct 86

[Text] Beijing, 4 October (XINHUA)--Government scientists are investigating links between environmental pollution and cancer and heart disease, participants at a national conference on pollution control were told today.

Officials at the conference said scientists are also studying the effects of pollutants on human health and on animals and fish.

Research on pollution control is a top priority in China's current 5-year plan.

At the meeting, environmental pollution experts said the health of the Chinese people was being jeopardized by water pollution, careless disposal of liquid and solid wastes, release of radioactive dust and toxic chemicals into the air, unauthorized destruction of forests and grasslands, and noise pollution.

For example, one scientist said, the Songhua River in northeast China has become a reservoir of potentially deadly wastes. "We found 264 toxic organic compounds in the river," he said, "and 10 of them can cause cancer."

Another scientist reported that the density of suspended dust in the city of Mudanjiang in Heilongjiang Province in northeast China exceeds that of London in 1952--when air pollution in London was at its worst.

Cheng Boxing, an engineer at the China Environmental Science Research Institute, called for recycling industrial wastes.

"The garbage of metallurgy, chemical and power plants contains radioactive and other toxic materials, yet it is heaped on open-air dumps," he said. "If this continues it will pollute the air we breathe, the water we drink and the farmlands we depend upon for our food."

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CSO: 4010/18

ENVIRONMENTAL QUALITY

STEPS TAKEN TO REDUCE POLLUTION IN PEARL RIVER DELTA

OWO60741 Beijing XINHUA in English 0624 GMT 6 Aug 86

[Text] Guangzhou, 6 August (XINHUA)--Work is being intensified in the Pearl River Delta in Guangdong Province to control industrial pollution, a by-product of peasant prosperity.

One example is Shunde County, one of the 16 in this richest part of the province and one of the richest in China, which forbids the building of any factory without pollution control facilities, officials here told XINHUA today.

Since 1982, Shunde has promulgated nine local legislations on rural pollution control, one stipulating that control facilities must be erected simultaneously for any new factory liable to cause pollution.

The recent years have seen an industrial boom in the rural areas of the delta, thanks to the policy of encouraging a diversified, market-oriented rural economy.

But pollution goes hand-in-hand with prosperity, the officials said.

Shunde, for example, has 1,000 rural electroplating, chemical, and paper-making factories, whose sewage and materials once polluted pond water and killed fish. This endangered the country's position as the province's top fish breeder.

In each of the 16 counties and cities in the area, there are thousands of industrial enterprises run by peasants or rural collectives--or "township enterprises" as called in China. Their income accounts for more than half of the total rural economic income in the area.

While tightening pollution control measures on new factories, local governments are also helping transform some of the existing rural enterprises.

In addition, they have helped build facilities to treat sewage and materials discharged by textile, sugar refining, food, paper making, electroplating, and cement factories--all major pollution sources in the countryside of the Pearl River Delta.

Dongguan, a city also in the delta, closed more than 20 rural factories that caused severe pollution.

Another step to control pollution taken by rural enterprises in the Pearl River Delta is to establish industrial zones separate from peasants' residential areas.

In Dongguan, all its 33 townships have established such industrial zones accommodating 109 factories.

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CSO: 4010/18

ENVIRONMENTAL QUALITY

POLLUTION MONITORING SYSTEMS BEING UPGRADED

OW310834 Beijing XINHUA in English 0555 GMT 31 Aug 86

[Text] Beijing, 31 August (XINHUA)--China has improved its environmental monitoring system and worked out some relevant regulations, the current issue of HEALTH NEWS reported.

A participant in global environmental monitoring, China has upgraded its monitoring levels by absorbing foreign advanced technology and experience, the paper said. In many areas, the work to monitor drinking water has been regularized and systemized, the paper said, adding that 90 percent of drinking water in large and medium-sized cities is being monitored. Epidemic prevention stations in all parts of China have also joined in studying pollution effects. The relation between air pollution and diseases in the human respiratory system has been studied in 26 cities, the paper said.

In addition, some regulations and decrees on pollution monitoring and controlling have been worked out, the paper said.

"Regulation on sanitation of public swimming pools," worked out by the Ministry of Public Health and the State Physical Culture and Sports Commission, has already been put into practice.

And "regulation on sanitation in public places" is under consideration by the State Council. "Regulations on sanitation of drinking water" and "regulation on sanitation of cosmetics" are being drafted," the paper said. [quotations as received]

According to a survey, 17 of 32 cities investigated have already promulgated or will promulgate 28 regulations or decrees on environmental sanitation, the paper said.

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CSO: 4010/18

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

NATIONAL COMPUTER SOCIETY MEETING HELD IN FUZHOU

OW130928 Beijing XINHUA in English 0706 GMT 13 Dec 86

[Text] Fuzhou, 13 Dec (XINHUA)--China should put an end to developing different kinds of computers without regard to production needs and give priority to developing types which are badly needed.

This is a suggestion put forward by leading Chinese computing experts at the annual meeting of the China National Computer Society held recently in Fuzhou, capital of east China's Fujian Province.

China has already trained more than 100,000 technical workers in the computing field, and micro-computers are being used by different economic sectors and scientific institutions.

But, by reviewing China's experience in developing computer technology over the past three decades, the experts said, "We should acknowledge our gap with technologically-advanced countries in information technology and industry."

In the past, China gave fairly equal efforts to developing gigantic, large, medium-sized, small and micro computers.

China's development of computer technology should be based on forming a computer market and achieving better economic results, the experts said.

The computer industry in China must go into international competition as well as developing the domestic market, they said.

In this regard, there is a need to import and assimilate advanced computer technology from other countries, they stressed.

The experts proposed that China carry out cooperation with other countries through technical transfers, and cooperative research, development and production.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

BRIEFS

CHINESE CHEMISTS HONORED--Fuzhou, 14 Nov (XINHUA)--Two of China's leading chemists were honored here today at a seminar to mark their achievements over half a century. The seminar, which was jointly organized by the Xiamen city government and university, honored Lu Jiaxi, president of the Chinese Academy of Sciences, and Cai Qirui, chairman of the academic committee of the university. The two professors were granted certificates of honor by the Chemical Society of China at the seminar, which was attended by over 200 specialists from both China and abroad. According to a seminar official, both professors were born in Xiamen and graduated from the university's department of chemistry. They both studied and worked abroad, and returned to teach at the university in 1945 and 1956, respectively. Having written numerous papers in the field, the two achieved fame in 1973 when they jointly put forward the theory of "string-bag" structural models of the active center of nitrogenase, the spokesman said. Lu has been elected to the Third World Academy of Sciences, he said. Speaking at the seminar, professor Tian Shaowu, president of the university and a former student of Lu, spoke highly of his former tutor and professor Cai. "We must learn and carry forward their noble spirit of loving China and contributing to science and education," he said. [Text] [Beijing XINHUA in English 1546 GMT 14 Nov 86 OW] /6662

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